A TREATISE

ON

MATERIA MEDICA, PHARMACOLOGY,

AND

THERAPEUTICS.

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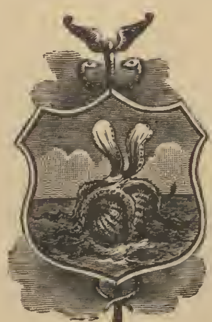
IN TWO VOLUMES.

VOLUME I.

DEVOTED TO PHARMACY, GENERAL PHARMACOLOGY AND THERAPEUTICS, AND REMEDIAL AGENTS NOT PROPERLY CLASSED WITH DRUGS.



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PREFACE.

THE labor attending the preparation of a work such as that now for the first time offered to the medical profession can only be appreciated by those who have attempted literary effort in the midst of an exacting general practice, and yet it is not infrequently the case that such engrossing duties will not only spur the writer to greater activity, but will so affect his mental development that his productions will reflect in a measure his deliberate conclusions upon matters which may be in dispute merely on theoretical grounds. Some are content to make a simple record of what may come under their observation; they deal in facts which admit of mathematical demonstration. Others are disposed to revel in imagination without regard to facts, or possibly the facts may be made to do duty for purposes the opposite for which they were originally intended. There are still others, and with whom we desire to be classed, who study what they see, reflect upon what has been recorded, and deduce from the knowledge thus acquired the inferences warranted by the facts. In the preparation of the following pages this method has been adhered to, except in the case of theories which may have been advanced to account for conditions that are, as yet, inexplicable under the most rigid laboratory and scientific tests at present available.

A new work upon therapeutics must cut loose from the traditional heresies that have been handed down from time immemorial, but it should not condemn as obsolete empirical

methods which have shown their value in times gone by; on the contrary, we should strive to learn the secret of the successful application of remedies that baffled the generation of physicians who preceded us. In this laudable attempt much has been accomplished within a decade in well-equipped laboratories in the domain of experimental therapeutics, but, unfortunately, of late, the tendency is to carry this investigation a step farther than is required for our purpose. The department of experimental toxicology is in marked contrast with that of therapeutics, and it may be recorded here that, in the opinion of the authors, but little is to be gained to practical therapeutics by the needless repetition of well-established operations which require the exhibition of lethal doses of drugs whose physiological action is thoroughly understood. No true and reliable system of treatment can be based on such experiments, nor upon the experiments of physiologists on persons enjoying apparent health, although such observations are of some value in aiding the physician to determine the special direction manifested by a drug used as a toxic agent. In disease the entire nervous system is so affected that the action of a drug thus studied cannot be estimated, and, as a consequence, we are compelled to be guided in many instances by these observations and by experience rather than by physiological tests, but our deductions are not to be based upon these alone to the exclusion of facts brought out in the course of investigation; chemistry, pathology, and our knowledge relating to micro-organisms must also be taken into account.

These features, as well as the reasons for the adoption of a method of classification, have been so fully discussed in the introduction that they need not be further considered here, and to that section of the work, therefore, the reader is referred.

A word should be added concerning the difficulties encountered in the preparation of a treatise such as this, owing to the recent advances and changes in methods of treatment brought about by late pharmacological investigations and by the discovery of numerous synthetic products which have been added to the *armamentarium* of the physician. The opinions of different observers are so at variance with each other that the facts connected with the use of these newer remedies cannot be properly estimated without further observation. The literature upon the subject of antipyrin alone would make a good-sized volume, while the claims for antifebrin and those preparations that have been offered as substitutes for it are sufficient to warrant giving it more space than can be spared in a work of this character. The discovery of the analgesic properties of cocaine has effected a revolution in ophthalmology, and the various uses of this drug have multiplied so rapidly that the general practitioner can scarcely keep track of the advances made from month to month. The applications and remedial powers of the salicylates have also been greatly extended within the past few years, while the views at first entertained concerning the subject of bacteriology have lately been materially modified, all going to show that the present is a period marked by more energetic clinical and laboratory work than ever has been witnessed heretofore.

The result of this increased activity in all departments of medical science has developed the need for presenting the subject of therapeutics in a manner which shall fully express the most recent information in compact form, and has determined the authors to postpone the issue of the second volume until such time as would permit them to go over the entire ground again in the special department of

drugs. This plan will involve no additional expense to the purchaser, while it has the advantage of presenting the subjects treated of in the different volumes separately, and he is thus permitted to secure at intervals books for which he may experience a special need,—two important considerations. The convenience of handling smaller volumes, it is believed, will also facilitate study and consultation.

In conclusion, it may be added that the general plan is elementary in character, intended to develop in the minds of students and practitioners habits of study conducive to advancement and to independence in thought, along with decision in the matter of treating disease; and, with this commendable purpose in view, the work is respectfully placed before the medical profession in the hope that it may find a welcome in keeping with the care that has been given to its preparation. That it has faults cannot be denied; whatever excellencies it may possess we trust the reader will discover.

THE AUTHORS.

PHILADELPHIA, October, 1889.

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PART I.

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PART II.

Remedies and Remedial Agents Used in the Treatment of Disease not Properly Classed with Drugs.

INTRODUCTION.

WITH books, as with individuals, an introduction often forms an important factor in matters of business as well as socially, and is frequently referred to in after years as an exceptionally interesting link in a chain of events lasting through a life-time. The introduction to the present work is, therefore, intended to create a favorable impression, with the hope that its perusal will prompt the reader to further investigation; and, although it is impossible to transfer the substance of that which is contained in the following pages, a general idea of the character and object of the work can be given in comparatively few words.

As the title of the book indicates, the subject of **Therapeutics** comes last in order; but in the preparation of the work from beginning to end therapeutics has been the principal object in view, and the whole plan has been drafted solely for the purpose of adding to the facilities of students and physicians by increasing their knowledge of the methods of treating disease in its various relationships. The general plan of works of this class is gradually tending toward that of combining the **physiological relations** with the **therapeutical indications**; and, ordinarily, an **alphabetical** arrangement would be most convenient, but when that is adopted alone it must be admitted to be open to serious **objections.** An **illustration** will serve to show the difficulties in the way of following such a simple method: The bromides, for example, could be readily considered under that topic; the iodides would also appear to advantage under such a plan; but purgatives and antipyretics would fare badly, and we must, therefore, adopt a method which shall aid us in bringing together those remedies which affect the system similarly under like conditions; and as that trenches upon the physiological and toxicological effects of the different drugs, the various substances have been grouped in Part I under the head of **Pharmacology.** The **grouping** of these different products, it is believed, will aid the student in the selection of those measures best adapted to the wants of his patients. But from the fact that many remedies thus combined possess attributes which are distinct from each other, they must also be **studied separately,** and in the alphabetical arrangement the study of pharmacology relating to each particular drug has been prepared separately—Part III; and so far as possible this study has been for the purpose of further **extending** our knowledge of the **therapeutic value** and applications of the drug in question.

The study of **Therapeutics** is therefore permitted to follow immediately after the physiological action has been considered, and so far as possible an alphabetical arrangement has been adopted covering disease, but, of course, this method could not be followed up exclusively without seriously impairing the interest and value of the text. The idea of taking a **dictionary** or an encyclopedia for a **text-book** is ludicrous, and we have therefore made an effort to so collate the information upon **pharmacology** and **therapeutics** that the attention of the reader should not flag, nor should the information be of such a nature that the principles advanced could not be easily **understood** and **remembered.** Until medical lore can be taught by a system of mnemonics it is the sheerest folly to attempt to cram the brain with formulas which promise to relieve every ill that flesh is heir to. Formulas, however, cannot be despised from a financial point of view, because the prescriptions of some of our best-known physicians have been made to do duty for the manufacturers of proprietary preparations which have brought fortunes to the operators in the scheme. A reasonable amount of space has been given to the introduction of various **formulas,** which appear to be warranted, because they have a tendency to **assist the memory** and, at the same time, they **facilitate prescription-writing.**

The subject of **Materia Medica** has also received due attention in Part III of the work; and it is believed that the information conveyed upon this section will be appreciated by students and by the rising generation of practitioners. The advances in chemistry, and the improved methods of conducting physiological experiments, together with the very large number of products now in the market, have rendered this task **unusually laborious,** while the changes that are likely to be effected by further advances in scientific work combine to make this section of the work comparatively worthless after a few years except as a **matter of reference.**

Having now indicated the **general character** of the work so far as respects pharmacology and therapeutics, it should be mentioned that there is an **important class** of remedies used by the physician which are **not** as a rule drugs, although they are remedies for the relief of disease. Such, for instance, is electrotherapy, metallotherapy, hydrotherapy, and the number includes a considerable list which a quarter of a century ago were not considered within the range of **legitimate medicine.** Like chloroform and ether, and other methods now in vogue, they have had a **hard struggle** ere their value could be appreciated; and it may almost be said of them, as is said of Christianity, that their advancement has been accomplished only at the expense of anguish and suffering, for who can tell the woe of him who has failed to witness the fruition of his work in

his efforts to improve the condition of mankind? The chains have been stricken from the **insane,** while **hypnotism,** which has replaced **mesmerism,** steps forward to minister to their wants; the writhing and pain of **surgical operations** have been **quelled forever** by the discovery of **anæsthetics,** and recent investigations concerning the **microbic** origin of disease have enabled us to place an effective **barrier** against the appearance and spread of cholera, small-pox, diphtheria, and other **contagious diseases** which were the opprobria of the generation of physicians now retiring from the stage. Part II of the work has, therefore, very appropriately been set aside for the consideration of remedies and remedial agents which as a rule are not drugs.

Part I is devoted to various matters which demand the attention of those about to **enter** upon the **practice of medicine,** a short chapter being given to the consideration of the operations and preparations in **pharmacy,** in which the beginner is especially interested. In addition to the chapter on **Pharmacology,** with the **classification** which has been adopted, there has also been inserted a **Materia Medica classification,** showing the origin and character of the different drugs which we use, by which we are enabled to study the subdivisions of our therapeutic arsenal, and through which we may be able to locate them as **organic, inorganic,** or we can say whether they belong to the **Animal** or **Vegetable Kingdom.** A few hints are given upon the subject of **Prescription-writing,** and upon the **methods of medication,** as well as **other matters** relating especially to the **subject of therapeutics** in its most general acceptation.

Books of reference are valuable, not alone for the **isolated facts** they may contain, but also for the comparisons and contrasts which they bring forward, just as comparative anatomy is valuable, and just as historical information becomes interesting and useful. **Single facts** in matters medical, as in other affairs, are liable to be misleading, as they may **prove too much,** and hence the necessity of the sifting process to separate the chaff from the grain. A large number of remedies have been considered, and it is possible that some observations of recent date may have been omitted; but the aim has been to **deal justly** by all, acknowledging **merit** wherever found, and it is hoped no one will feel that his favorite remedy has been slighted.

PART I.

Materia Medica, Pharmacy, Pharmacology, and Therapeutics.

GENERAL CONSIDERATIONS.—For many years, in this country at least, the two departments of **Materia Medica** and **Therapeutics** have received the attention of writers and teachers to the exclusion of the other two equally important sections, **Pharmacy** and **Pharmacology,** which have been hitherto regarded as secondary, not specially demanding the attention of physicians. That changes have taken place in the minds of modern practitioners is apparent from the spirit of investigation which now pervades the ranks, the whole object of modern research indicating that **mathematical precision** shall take the place of exploded theories in the use of remedies directed against disease, and that so far as possible our **application of drugs** shall be in accordance with the deductions of **experimental physiologists,** coupled with the bedside observations of the **clinician.** From the exhaustive volumes of the eminent Stillé, devoted almost exclusively to **empirical methods,** we turn to some of the more modern works, whose authors have taken upon themselves the task of expounding the **physiological principles** underlying rational treatment, but in each there appears to be lacking that completeness which attends the maturity of an established science.

Clinically, therefore, our science of therapeutics must depend to some extent upon the skill we may be able to acquire when art steps in as a handmaid, and, while the authors do not claim any special qualifications beyond their brethren in the field, they have felt that an attempt to present the subject from the stand-point of **clinical therapeutics** would be appreciated by the student and the practitioner. In these preliminary remarks it should be stated that we disclaim any attempt to supplant other works of the kind, because nearly the entire list has been consulted in the preparation of the present volume, and we cheerfully bear testimony to their intrinsic merit, an acknowledgment which is abundantly confirmed by the adoption, in part, at least, of the features or special plans that already attest the prophetic vision of many whose works have preceded this one.

MATERIA MEDICA.

MATERIA MEDICA is a term used in medicine to cover a mass of information regarding drugs, embracing historical and scientific knowledge, all of interest and value to the physician. Not alone the charm of ancient use attracts the attention, but **botany** shares with **mineralogy** the reputation of having saved or lengthened human life, while **chemistry** steps forward to take the place of alchemy, and enables us to so conduct our observations and work that our records shall be complete. Briefly, it includes the **name of the drug**, together with such **synonyms** as may appear necessary for its proper distinction, the **source** from which it is obtained, the **physical characters** and **chemical properties**, together with a list of **preparations** made therefrom, and the **doses** of the same. In the present work an attempt has been made in this direction without giving that particular section undue prominence, with a view to supplying a demand that is gradually increasing for definite instructions as to the preparations in daily use. This department of the work was not decided upon without some hesitancy and misgivings as to its reception, by reason of the pressing **demand for therapeutics**, but we are convinced that the study has been neglected of late years, and with the present requirements of the better class of colleges, and State Examining Boards, our duty becomes imperative.

As a justification of the course, we may point to the records of **medical education** in vogue a generation since, in which a considerable portion of the student's time was taken up with the study of botany, a study that was practically of no benefit whatever, and one which receives comparatively little attention at the present day. Probably of greater importance to us than mineralogy, we have duly considered its relations, and, with each organic substance, the **Natural Order** to which it belongs will be found attached, as well as the part of the plant employed, and the habitat. A further evidence of the wisdom of this decision may be seen by referring to the plan adopted in treating of the **inorganic preparations**; the source from which they are obtained is given, the method of preparation is described, and it is firmly believed the information thus furnished will materially assist in filling an irritating lacuna found in medical students and recent graduates, who have not opportunities of consulting the pharmacopœia. All students, however, are not able to provide themselves with ample works of reference, and besides the department of materia medica is of sufficient importance to warrant more recognition than it has formerly received. The rapidly advancing **science of pharmacology** as presented herewith would be **incomplete** without a due consideration of materia medica.

A word should be added in defense of the position relative to the meagre reference to **chemistry,** as it may be said the subject is practically ignored. That the work is open to this objection cannot be denied, but when the fact is recalled that each student is required to attend a course of lectures and pass an examination upon chemistry, and that these lectures are especially intended for the **practitioners of medicine,** the burden is easily shifted from our shoulders.

An opportunity is here afforded for some observations concerning the **general plan** of the work in its relation to materia medica. This subject would be most appropriately considered by a **classification** that separated the different remedies from each other according to their physical or chemical properties. Thus, the organic substances should not be classed with the inorganic, and the latter would naturally be arranged in accordance with their chemical and other special characters; acids and alkalies should each receive separate consideration; the metals and non-metallic elements also appear in the same category; so with water, and so with the carbon compounds, and with substances obtained from the animal kingdom. But the aim of the present work being to advance the **interests of therapeutics,** a classification has been adopted which promises to further that object by contributing to its development, supplying valuable material with which to fill in the outlines of the picture. (See Pharmacology.)

As an aid, however, to those who may wish to follow up this method of study, the following **tabulated lists** have been prepared for the purpose of supplying a bird's-eye view of the **natural distribution** of the remedies at our command. While it serves an important purpose in this relation, its practical value can only be appreciated after years of experience, although its utility from a scientific stand-point is of the utmost importance. The headings of the respective groups are sufficiently explanatory to start the student in the proper line of investigation:—

Inorganic Materia Medica.

GROUP I—ALKALIES AND ALKALINE EARTHS.

Ammonium.	Cerium.	Potassium.
Barium.	Lithium.	Sodium.
Calcium.	Manganese.	

GROUP II—METALS.

Aluminum.	Gold.	Nickel.
Antimony.	Iron.	Phosphorus.
Arsenic.	Lead.	Silver.
Bismuth.	Manganese.	Zinc.
Copper.	Mercury.	

GROUP III—NON-METALLIC ELEMENTS.

Bromine, Chlorine, Fluorine, Iodine, } Halogens.	Charcoal.	Peroxide of hydrogen.
	Oxygen.	Sulphur.
	Ozone.	

GROUP IV—ACIDS.

Organic.

Acetic.	Gallic (pyrogallic).	Oleic.
Benzoic.	Hydrocyanic.	Salicylic.
Carbolic.	Lactic.	Tannic.
Citric.	Meconic.	Tartaric.

Inorganic.

Boric.	Nitric (oxalic).	Phosphoric.
Chromic.	Nitrohydrochloric.	Sulphuric.
Hydrochloric.	Nitrous.	Sulphurous.
Hydrobromic.		

GROUP V—CARBON COMPOUNDS.

Acetanilid.	Ethyl iodide.	Nitrous ether.
Acetic ether.	Ethylate of sodium.	Nitrous oxide.
Alcohol.	Ethidene bichloride.	Paraldehyde.
Amyl nitrite.	Fuchsin.	Petrolatum.
Antipyrin.	Hydrocyanic acid.	Phenacetin.
Carbolic acid.	Iodoform.	Pyrodin.
Chinolin.	Iodol.	Resorcin.
Chloral hydrate.	Kairin.	Salol.
Chloroform.	Methylene bichloride.	Thallin.
Creasote.	Naphthol and Naphthalin.	Trymethylamine.
Croton chloral.	Nitroglycerin.	Ural (uralium).
Ether.		Urethan.
Ethyl bromide.		

Organic Materia Medica.

VEGETABLE KINGDOM.

The Vegetable Kingdom includes the Natural Orders to which the plants belong, with the names of the plants used for medicinal purposes.

ANIMAL KINGDOM.

Cantharides.	Honey and Wax.	Ox-bile, purified.
Castor.	Ichthyol.	Pancreatin.
Cochineal.	Isinglass.	Pepsin.
Cod-liver oil.	Lanolin.	Soap.
Egg albumin and yelk.	Lard.	Spermaceti.
Formic acid, an arrow-poison obtained from red ants.	Leech, the.	Suet.
	Milk.	Sugar of milk.
	Musk.	

PHARMACY.

PHARMACY is the true art in medicine, although in this work but little prominence is given to it, because the physician is constantly dependent upon the local druggist for the preparations demanded by the sick. Generally speaking, pharmacy is divided into **two departments,—**

Official or Galenical pharmacy, and Extemporaneous or Magistral pharmacy. The former deals with the preparations of the **pharmacopœia,** while the latter includes the operations of the dispensing chemist as directed by the physician. Some knowledge of extemporaneous pharmacy is therefore requisite in order to comprehend properly the methods by which palatable and efficient preparations are exhibited to the patient in order to embrace these features in the prescription. The pharmacist, acting as a sentinel, not only aids the physician in avoiding **incompatibles** and unsightly mixtures, but it is also a part of his business to protect the patient against the errors or carelessness on the part of the physician; hence, a practical acquaintance with the preparations in use, either in the **laboratory** or **dispensary,** becomes of great value to the physician. A summary of the more common **pharmacopœial processes and preparations,** with a sufficient description to enable the student to appreciate their general character and applications, is appended herewith.

It should be mentioned that the **pharmacopœia** embraces a quasi-official list of drugs and preparations made therefrom, adopted by a joint committee appointed by the medical and pharmaceutical professions, and is subject to decennial revision. The simple fact that a drug has been omitted from its pages, or that one has failed to find a place therein, does not materially affect its value from a therapeutical standpoint, as the opinions of clinicians as well as the methods of treatment are liable to modifications, and during a period of ten years vast changes are likely to take place. The admission is freely made that much in the present pharmacopœia might with advantage to the profession be eliminated, and in the present work, in the consideration of any drug which has not received its sanction, the fact will be indicated by classifying it as "**unofficial.**" All preparations not so specified may be found in the pharmacopœia (U. S.).

OPERATIONS.

ANALYSIS.—For the purpose of detecting the presence of poisons, and for other purposes, the pharmacopœia directs that both qualitative and quantitative methods be employed, and of the latter either the volumetric or gravimetric may be advised. **Testing** is frequently necessary for the purpose of determining the purity and strength of preparations offered for sale, and is especially valuable in fixing the **standard** of certain organic substances whose virtues depend upon the presence of alkaloids. Thus, aconite, belladonna, cinchona, opium, and other well-known drugs depend for their activity upon the presence of **certain alkaloids,** and without definite information regarding this very important item, much uncertainty will attend their use in the treatment of disease. This matter should not escape the attention of the physician, and we have endeavored

throughout the work to impress upon the mind of the reader the necessity for prescribing only such organic drugs and preparations made from them which have been subjected to this precautionary investigation with a view to ascertain their alkaloidal purity. **Assaying** properly comes within the scope of the practical pharmacist, while the simplicity of the apparatus and operations required, coupled with its importance to both patient and physician, all seem to warrant the physician in insisting upon this method being adopted wherever practicable. The **metric** system is recommended for all work of this class.

BOILING OR DECOCTION.—Decoctions are prepared by placing the substance to be treated in a covered vessel with a specified amount of cold water and applying heat until the boiling-point is reached, when it is continued for a certain length of time. When **concentration** is ordered, the vessel should remain uncovered, heat being applied until **evaporation** has reduced the contents to the desired limit. When it is necessary to obtain the **active principles** of organic substances quickly, the application of heat is required, but should not be too long continued, and the physical characters of the product may demand that it should be previously bruised, sliced, or macerated in cold water. Decoctions **should not be ordered** where the active principle is volatile at the boiling-point, nor when heat affects its virtues, nor in the case of those drugs giving forth a nauseous principle on the application of heat; and when prepared the product should be strained while warm. The foregoing exceptions do not apply to infusions, which are less objectionable to the patient. It is a matter for congratulation that the official number of decoctions has been reduced to two, and it is believed that no physician will be seriously affected by thus limiting the bulky preparations which were so repugnant and distasteful to patients a generation ago.

BRUISING OR CONTUSION.—As stated in the foregoing paragraph it is frequently necessary that the substances wanted for decoctions, infusions, etc., should be submitted to some previous manipulation for the purpose of rendering them more amenable to treatment. A more extensive surface is afforded for the action of the solvent by breaking down the cohesion by pounding or bruising in a suitable mortar, and when not specified by the physician, the pharmacist will fail in his duty should he omit it.

CALCINATION consists in the application of heat to any substance for the purpose of driving off water or volatile constituents, or the absorption of oxygen, the residue being left in a finely-powdered condition without fusion. In this manner magnesia and lime are prepared from their carbonates. The substance to be calcined is placed in a crucible and introduced into a furnace, the operation sometimes being called

incineration. **Exsiccation** is the term applied to the vaporization of the water of crystallization from a crystalline body, whereas in the preparation of lime and magnesia it is carbonic acid and water which are removed by the operation.

CLARIFICATION is a modified form of filtration, and is used for the purpose of purifying liquids and semi-solids, such as honey, lard, suet, etc., by melting or heating and straining while warm. This process is sometimes referred to as that of **colation** or **straining**, but there are other methods of clarification which should be named. When a liquid substance is allowed to stand, impurities in the form of a sediment will be deposited; a similar result follows the development of fermentation, or a liquid of a different density may be added, or albumin, gelatin, milk, and various substances according to the character of the substance to be acted upon.

COMMINUTION is practically another name for bruising already referred to, and embraces various mechanical operations, such as cutting, rasping, grating, crushing, stamping, grinding, pulverizing, triturating, levigating, elutriating, granulating, etc., for which purpose a variety of instruments are used.

CRYSTALLIZATION is applied to the change which takes place in substances whose form is modified into definite and regular geometrical forms called crystals when they undergo solidification, either by cooling, by evaporation, by fusion, by sublimation, or by precipitation. The process of crystallization is hastened by the presence of foreign bodies, as threads, and by agitation, but it will be observed that the more slowly the progress of the change the larger and more perfect will be the crystals. In the case of some preparations, as the sulphate of iron, the water of crystallization being driven off materially **increases the strength**, so that the dried sulphate is about twice the strength of the crystals.

CARBONIZATION refers to the method by which the volatile constituents of organic substances are destroyed without exposure to atmospheric air, the residue having the characteristic appearance of carbon. It differs from incineration in respect to the carbon, which in the latter is consumed because of its exposure to the air, leaving only the ash as a residue.

DECANTATION is a simple operation, and consists in pouring off gently, by inclining the vessel, any liquid containing a deposit, and may often be permitted to take the place of filtration or colation.

DECOLORATION is conducted for the purpose of removing any coloring matter which may be present in substances such as alkaloids. The material is combined with powdered animal charcoal either as a solution or mixture, and the whole filtered.

DEFLAGRATION.—Certain inorganic substances, when heated, yield up oxygen with resulting decomposition and sudden combustion, to which the name of deflagration has been given. Both nitrates and chlorates possess this quality, and, without due caution on the part of both physician and pharmacist, explosive compounds may be placed in the hands of patients.

DESPUMATION is another method by which organic liquids are purified by the application of heat, as contradistinguished from clarification. Whatever impurity may be present rises to the top, and may be removed by skimming or filtration. This process is especially valuable in the preparation of green extracts, and has been found useful in the preparation of syrups, which are said to keep much better when subjected to despumation. The difficulty in preparing stable preparations in which sugar is the base has been charged to the adulteration of the sugar, but this objection may be overcome provided saccharin can be introduced as a substitute.

DESICCATION is the name given to the process of drying that is frequently required in connection with pharmaceutical preparations. No rules are given for the proper drying of roots, leaves, seeds, etc., but it would naturally be assumed that a regular supply of heat should be kept up until such time as the substances had been deprived of the greater portion of their moisture, and practically it has been found that a temperature ranging from 100° to 130° F. is best adapted to the purpose, the material being properly disposed to avoid overheating. In certain countries exposure to the sun has been found efficient. Certain substances, requiring a higher temperature than that mentioned, may be dried upon a water-bath, while others, like the sulphate of iron, will require a much greater heat to drive off the water of crystallization. Various substances are used for the purpose of assisting in the drying process, as carbonate of potassium, lime, sulphuric acid, etc., and in the preparation of pills by manufacturing chemists this practical fact is taken advantage of with a view to avoid the undue application of heat, and consequent destruction of the medicament.

DIGESTION is merely another name for **maceration**, both being conducted for the same purpose; the difference lies in the fact that by the former process the activity of the substance is sought to be obtained by solution at a temperature higher than the surrounding atmosphere, but not as high as the boiling-point.

DISTILLATION is conducted by means of a variety of different processes, all having for their object the conversion of a liquid into a vapor by the application of heat, and the vapor again converted into a liquid by condensation in another vessel. The process of distillation, there-

fore, consists of two operations,—that of ebullition, or boiling, by which the volatile substance is converted into vapor, and that of condensation. **Destructive or Dry Distillation** is a term applied to the method of obtaining by the application of heat volatile products which did not previously exist in that body, as in the preparation of acetic acid and tar from wood. Dry distillation also refers to the process by which, in a mixture, different substances are acted upon at the same time, but, being volatile at different temperatures, the products may be received in separate vessels according to the amount of heat supplied.

Several **objects** are **attained** by distillation: Impurities ordinarily found in water and other fluids may be removed, as otherwise they would be unfit for certain pharmaceutical purposes; volatile products which could not be combined in the preparation of waters are thus secured and made available for various purposes.

Certain **precautions** are to be observed in the practice of distillation; to avoid impurities from the worm, or receiver, both should be of block-tin or glass, as the ordinary tin-coated sheet-iron which passes for tin is wholly unsuited for the purpose. When a still is used indiscriminately for different products, the most scrupulous care is demanded in order to avoid impurities, and the most thorough **antiseptic measures** should be adopted with a view to prevent contamination. More especially is this true in the preparation of distilled water, from the fact that natural water contains, besides carbonic acid, other volatile impurities, and a reasonable degree of care is required to avoid giving it an empyreumatic taste by too long continuing the process. With a view to avoid collecting ammonia, which is to be found in all natural water, the **first products** of distillation, to the extent of one-twentieth, are directed to be thrown out, and, should any ammonia be found, sulphate of potassium should be added and the product redistilled. Volatile nitrogenous matters remaining in the distillate may be destroyed by the addition of potassium permanganate and caustic potash, when it is again passed through the still. As a rule, all **alkaloids** require the presence of distilled water for their **solution,** and when these are intended for use at infrequent intervals, or likely to be kept long on hand, a suitable **antiseptic** must be added to secure their preservation from the deleterious influences of micro-organisms.

Dialysis is the name applied to a process introduced by Professor Graham, having for its object the separation of crystalloid from colloid substances. It depends for its successful application upon the principles governing **osmosis** and the diffusibility of liquids, and although not adopted officially its value has already been fully demonstrated in the department of pharmacy. **Crystalloids,** it should be noted, are sub-

stances possessing crystallizable properties, while **colloids** are substances lacking this property, but capable of forming with water a gelatinous mass; and while the former are readily diffused, as in the case of sugar, the latter, of which gum is a pertinent example, diffuse themselves but slowly. The most **simple dialyzer** consists of a bladder containing the substance in solution to be dialyzed, which is suspended in a vessel containing the liquid intended to take up the diffused crystalloid. After exposure for a length of time, depending upon the character of the complex substance, it will be found that the crystalloid body has become separated from the colloid body, and will be recovered from the liquid in which the bladder was suspended, called the **diffusate.** Parchment paper or any similar material may be used as a septum, but dialysis is only applicable to substances held in **watery solution.**

The following **applications of the process** have been recommended to the pharmacist: To facilitate the **separation** of the active matter of any **artificial or natural mixture** containing active crystalline and inert colloidal material; to aid in the **recovery of poisons** from organic mixtures by removing them from a mass of inert material which interferes seriously with the use of reagents; to **recover salts** and other crystallizable substances used in the various pharmaceutical operations which would not repay more expensive methods of procedure; to **restore salted meat** to the fresh state by inclosing it in a bag with a quantity of its brine, and immersing the whole in sea-water for several days, which causes the salt to disappear. Some years ago a class of preparations was introduced to the profession known as **Dialysates,** said to contain the active constituents of plants free from inert matter, but so far the effort has not met with general success.

ELUTRIATION is a process somewhat resembling sifting, except that it is used with water for the removal of sand, gravel and other impurities. It includes also the method of powdering insoluble substances, mixing with water, so that the finer portion may be poured off, leaving the coarser particles at the bottom of the vessel.

EVAPORATION is simply another name for concentration, by which the volume of a liquid is reduced and the volatile principles eliminated, and is used chiefly in the preparation of **extracts, fluid and solid,** and the **crystallization** of salts. The vessels used for this purpose should be shallow, and only moderate heat employed, not to exceed 140° F., and the nearer the liquid is maintained to the boiling-point the more rapid will be the progress of evaporation; but on account of the disposition of vegetable substances to **deteriorate** from long-continued **application of heat** only small portions should be subjected to this process at a time. The use of a steam-, water-, or sand- bath enables the operator to regulate

the heat, and constant stirring will materially hasten the operation. Vacuum pans are employed in large **laboratories**, by means of which a much less degree of heat is requisite for evaporation.

Spontaneous Evaporation is that form of concentration which takes place at ordinary temperatures, and is adapted to those cases in which the substance is liable to be injured by the application of heat.

EXPRESSION, as its name implies, is an operation by which we obtain liquids, as juice or oil, from vegetable substances, or for the removal of the spirit or tincture from the **marc** after maceration or percolation. As contradistinguished from distilled products, oils so obtained are called expressed or fixed oils.

FILTRATION is the most perfect mechanical method of separating an insoluble substance from a liquid. It is variously performed by causing the liquid to pass through filter-paper, felt, linen, muslin, charcoal, sand, and other materials; colation or straining is a less perfect but more rapid method of accomplishing the same purpose.

FUSION, LIQUEFACTION, OR MELTING have for their object the changing of solid substances into liquid by the application of heat without the use of a solvent, and are extensively employed by pharmacists in making ointments, plasters, caustic-stick, purifying resins, and for the purpose of decomposition. The degree of heat applied varies from a temperature of 90° to 800° F., and water-, steam-, and sand- baths are frequently employed to insure a more regular and constant supply of heat.

GRANULATION is performed where it is necessary to reduce a crystalline salt to a granular powder; this object is effected by dissolving the salt in water and evaporating the solution, agitation or stirring being kept up until the product becomes dry.

IGNITION is employed in pharmacy in quantitative analysis, and is performed by heating the substance as in the case of incineration, the residue being the desired product.

INFUSION has already been referred to under the head of decoction, from which it varies but slightly. The substance to be acted upon is treated for a short time with water in a covered vessel. The temperature of the water for infusions will vary according to the character of the substance, certain bodies of vegetable origin yielding their virtues to cold water rather than hot water, and *vice versâ*. Infusion of calumba is made with cold water, because hot water affects the starch it contains, and quassia also gives up its bitter principle readily to cold water.

LEVIGATION is a name applied to a process similar to elutriation, except that the former is employed for the reduction of more expensive substances than is adapted to the latter, where the residue is thrown away. Insoluble substances to be submitted to this process are first

ground into the form of powder, the finer portions being secured by the addition of water, and the coarser particles returned to be re-ground, and thus the process is repeated until the requisite degree of comminution is secured.

LIXIVIATION is practiced in order to dissolve out a soluble salt from a compound or mixed solid by the use of water and subsequent evaporation of the solution.

MACERATION is sometimes practiced as a preliminary to the preparation of infusions and decoctions, the liquid generally being alcohol, in which the comminuted substance is placed. The liquid used in maceration is called the **menstruum**; the insoluble matter remaining after expression is called the **marc.**

Maceration differs from **digestion** in that it requires a longer time for its completion, and the use of an alcoholic menstruum, as in the preparation of tinctures, instead of water.

PERCOLATION OR DISPLACEMENT are names applied to the method by which, through the agency of a suitable solvent, we obtain the soluble ingredients of a substance prepared in the form of powder, and is largely used in the preparation of tinctures. No little skill is required for conducting the process successfully, and much depends upon the character of the substance to be acted upon. This is generally in the form of a fine powder, but the degree of comminution must be regulated by the character of the drug. If too fine it becomes impermeable to the menstruum, and prevents its descent; if the powder is too coarse the spirit fails to saturate the particles, and the active properties are not recovered. To overcome this objection the pharmacopœia directs the degree of fineness requisite for the more important tinctures by requiring the powder to be previously passed through sieves of definite dimensions. The **process of percolation** may be thus described: The substance, in the form of powder, which is to be subjected to the operation, is packed in a short, wide tube, closed at one end by tying a piece of muslin or flannel over it and pouring into the tube the menstruum; as the liquid gradually filters its way through the column of powder, the soluble ingredients are dissolved and drop into the receiver below. In some instances it is better to first combine the menstruum with the powder before placing in the percolator. The **mixed form** of first macerating and then percolating is preferable to either process used alone. To prevent closure of the pores in the column of powder, a layer of pebbles or fine sand may be placed at the bottom of the tube. The vessel holding the powdered drug is called the **percolator**; the liquid used as a solvent is the **menstruum** until it reaches the receiver, when it is termed the **percolate.** Minute instructions for percolation will be found in the pharmacopœia.

PRECIPITATION consists in the separation of solids from their accompanying solution, and may be accomplished by various processes,—by chemical reaction, by adding another liquid in which the substance is insoluble, by heating albuminous solutions, and by exposing solutions of silver salts to the light. The separated substance is called the **precipitate,** which may either rise to the top, remain suspended, or it may fall to the bottom. The substance producing this effect is called the **precipitant,** and according to their appearance precipitates are spoken of as curdy, crystalline, flocculent, gelatinous, etc.

PULVERIZATION is useful for reducing solids to the form of a powder. All vegetable products lose a large percentage in weight by drying and powdering, the result being a gain in strength over fresh herbs. These dried vegetable products are ground in a mortar or mill, after which the particles are passed through a sieve, the meshes of which are arranged in accordance with the fineness of the powder required; that which fails to pass through the sieve at first trial may be again subjected to the grinding process. Camphor and spermaceti can only be powdered by adding a quantity of alcohol and triturating. Some substances can be powdered only by levigation, others by granulation, and still others by chemical processes.

SEPARATION is a mechanical process, and is accomplished by the use of pipettes, funnels with stop-cocks in their necks, by means of which the separation of liquids which do not mix with each other is effected.

SIFTING has already been referred to. It is a simple mechanical procedure by which the coarser particles are separated from the fine by the use of sieves variously made of fine wire, horse-hair, or muslin. Sifting, when applied to fruit, is called "**pulping,**" which differs from the former with respect to the method of conducting the operation; in the latter force is necessary, while in the former it should be avoided.

SOLUTION, as applied in pharmacy, may be either simple or chemical; in the former the substance dissolved may be recovered by evaporation, while in the latter recovery in its original form may be impossible. A solution is said to be saturated when a liquid ceases to dissolve additional portions of the substance after trituration and the application of heat. After cooling, a portion of the solution just described will be deposited in the form of crystals, when it is called a **cold saturated solution.**

SUBLIMATION is a method of procedure by which arsenic is prepared. The solid from which it is obtained is reduced to a state of vapor when condensation takes place, and it is deposited on the surface of the receiver as a **sublimate.** In the preparation of sulphur the vapor

is condensed in a feathery condition called **flowers.** Sublimation differs therefore from destructive or dry distillation.

TORREFACTION OR ROASTING is practiced for the purpose of modifying the character of organic substances, as in the roasting of coffee, the degree of heat being less than that for carbonization.

TRITURATION has of late become a very important branch of pharmacy; the large number of remedies which are now used in the form of triturates requires that this process should be fully understood by the retail druggist, although he will be unable to prepare them in small quantity in such perfection and at the low prices which large manufacturers can offer.

The pharmacopœia directs for trituration that some inert or gritty powder be used, sugar of milk (saccharum lactis) being named, and that the substance to be acted upon shall be combined with this product in certain proportions, and the entire mass exposed to grinding or rubbing in a mortar until the requisite degree of comminution is secured. A more detailed description will be found under this heading in the section relating to preparations. Pulverization, levigation, and elutriation are all modified forms of trituration, and are useful according to the demands of the pharmacist and the physical character of the body to be acted upon.

WASHING, as practiced in pharmacy, is sufficiently expressive in itself; it is a mechanical operation, having for its object the separation of soluble from insoluble substances, and is sometimes referred to as **ablution** or **affusion.** The method varies according to the character of the body and the amount of work to be done, but it can usually be accomplished by means of one or more wash-bottles, so arranged that either a continuous or intermittent stream of water can be used.

PREPARATIONS.

The different **pharmacopœial** preparations have been presented by various methods of **classification.** In the following summary it has been deemed advisable to consider them in **alphabetical order.** In a general way they are divisible into two classes, **liquid and solid,** a brief description being appended herewith.

Liquid preparations include those spoken of as acetous, alcoholic, aqueous, ethereal, and oleaginous—terms sufficiently indicative of their methods of preparation. **Solid preparations** include all those ordered by the physician other than those in the form of liquids. The authors at first favorably entertained the idea of adding to the following comments various details concerning the composition and dosage, the source from whence obtained, the materials and menstruum used; but as this informa-

tion is appended under the appropriate heading in the body of the work, this plan was finally abandoned, as doubts are entertained as to the utility of such information in a book of this character. The conditions attending the exhibition of drugs are so variable that any set **posological table** must be comparatively worthless.

ABSTRACTA.—Abstracts are of comparatively recent introduction in pharmacy. They have been prepared with a view to secure products which bear a definite relation to the drug, and are superior to powdered extracts, owing to the loss of strength attending their manufacture, and their disposition to absorb moisture with subsequent decomposition. The **strength** of abstracts is double that of the corresponding fluid extract, and about ten times the strength of the tincture. They are prepared by evaporation at a low heat (120° F.), the addition of sugar of milk and trituration, so that the finished product weighs one-half as much as the **fluid extract.** When prepared from an alcoholic fluid extract, free from glycerin, it will be found convenient to add about one-fourth its weight of powdered sugar of milk, then drying, and finally making up the quantity to one-half the weight of the fluid extract by the addition of more sugar of milk. The strength of this abstract when made from an assayed fluid extract, is definite and uniform, and, besides, it is not liable to be affected by changes of climate, but should be kept in well-stoppered bottles, and, as far as possible, free from moisture.

The number of abstracts recognized by the pharmacopœia is eleven, viz :—

Aconite.	Hyoscyamus.	Podophyllum.
Belladonna.	Ignatia.	Senega.
Conium.	Jalap.	Valerian.
Digitalis.	Nux vomica.	

ACETA.—Vinegars are solutions of medicinal substances in vinegar or dilute acetic acid, but, as vinegar contains principles favorable to decomposition, the pharmacopœia now directs the use of dilute acetic acid. Solutions prepared in this manner are liable to undergo destructive changes; the addition of alcohol, while contributing to their preservation, is liable to produce precipitation and the formation of acetic ether, and is otherwise injurious; it is, therefore, advisable that vinegars should be prepared only in small quantities. They are of uniform strength and represent 10 per cent. of the crude drug, and, judging from the efficiency of **acetic alkaloidal preparations,** vinegars are entitled to our favorable consideration. The official number is four, viz :—

Lobelia.	Sanguinaria.
Opium.	Scilla.

ALKALOIDEA.—Alkaloids are definite basic substances obtained from plants, and represent their active principles. They differ from **glucosides** by forming salts with acid radicals, and from certain **neutral principles** in being more reliable and certain in their physiological action. These substances occur in the form of crystalline bodies, or as oily liquids, and are found in the plants in combination with acids; as a rule, they are not soluble in ordinary menstrua, but their salts are readily soluble in water or other media, and the smallness of the **dose** can thus be **definitely apportioned,** a feat which is difficult of accomplishment when an attempt is made to divide a minute portion into a limited number of pills or powders, as frequently happens in extemporaneous pharmacy. The certainty of their action, coupled with the fact that there are no impurities combined with them, such as is often met with in ordinary liquid preparations, would seem to favor their use instead of the more crude preparations, and to a certain extent this is true, but it is not altogether available for the whole number of alkaloids, as we know that some of the alkaloids do not fully represent the physiological action of the drug as generally applied. This latter observation will apply to ergot and to digitalis, neither of which are fully represented by the administration of their respective alkaloids; but, on the other hand, the use of strychnine is generally conceded to be superior in its action to that of nux vomica. Until the physiological action of the alkaloids has been studied as thoroughly as the crude drugs in the treatment of disease, it will be within the discretion of the physician to make his own selection in those cases where any question is likely to arise.

While the small **size of the dose** is sufficient to make these preparations desirable to some physicians, there are others who may object to using such powerful remedies, especially in the treatment of children; but this objection will vanish after a careful study of the remarks upon **triturations**, farther along in this section of the work. So general has become the use of quite a large number of alkaloids, glucosides, and neutral principles, such as resins, etc., that a limited number of practitioners have adopted a name to distinguish their special mode of practice, by announcing themselves as "**Dosimetrists,**" but, of course, such a method is open to the severest censure. Deviations such as we see in the methods of homœopathy, dosimetry, hydropathy, eclecticism, and other isms, do not demand attention at our hands; whatever is found useful from the appropriate use of water, we shall not hesitate to recommend; if **alkaloidal therapy** is preferable in certain instances, we have no objection to the method as such, but when small doses of alkaloids or other remedies are recommended, it does not follow that our faith is pinned to homœopathy, as such methods of practice can be demonstrated

as coming within the range of **scientific medicine** without recourse to the hallucinations of enthusiasts who would introduce a "**System,**" with the discovery of every new remedy, but it would require a complete re-adjustment at the end of each decade, in order to adapt it to the demands of the science.

AQUÆ.—Medicated waters are simple solutions of volatile substances obtained by distillation or other processes. Either some part or the whole of a plant or a volatile oil, or a gas, may be used in addition to distillation. Medicated waters are also prepared by solution in cold or hot water, by filtration and by percolation. Chloroform water and cherry-laurel water are not made from oil; camphor water is a solution without distillation.

Owing to the fact that all waters deteriorate with age, only such quantity should be prepared as is required for immediate use; when they are to be kept for any length of time, a suitable antiseptic must be added to prevent the development of micro-organisms.

The following **waters** are recognized by the pharmacopœia:—

Almond (bitter).	Chlorine.	Natural.
Ammonia.	Cinnamon.	Orange-flower.
Ammonia (fortior).	Creasote.	Rose.
Anise.	Distilled.	Spearmint.
Camphor.	Fennel.	

CATAPLASMATA.—**Poultices** are well known domestic remedies, and generally contain linseed-meal as a basis. No official directions are given for their preparation. When required by the physician they should be of such consistence as to accommodate themselves to the surface they are intended to cover without extension to adjacent tissues. They should be applied either warm or as hot as can be borne, and frequently changed, their value largely depending upon the heat which they supply to the affected tissues or organs. When too long continued, or allowed to remain *in situ* after becoming cold, or when applied after the subsidence of acute symptoms, their use is always attended with **deleterious effects.** A faithful observance of the foregoing precepts will be of inestimable benefit to both physician and patient. In the treatment of various classes of skin-diseases, of which eczema is a type, where the application of water is contra-indicated, their alternate use with other local remedies is frequently of great benefit, but, as a general rule, their **indiscriminate use** is strongly to be condemned.

The application of a properly selected quality of **ordinary clay** will often be found far superior to poultices in relieving pain, tension, and promoting suppuration.

The following substances are used in the preparation of poultices:

beer-yeast, chlorinated soda in solution, hemlock-juice, linseed-meal, and mustard. In addition to those just named, charcoal, powdered elm-bark and corn-meal, are all of value.

CHARTA.—Papers coated with an active substance are applied externally as irritants or sedatives, and are similar in their operation and effect to plasters. The active principle in them may be mustard or cantharides, and papers saturated with nitrate of potash are especially valuable for the relief of asthmatic attacks. It is used by burning, the patient in the meantime inhaling the fumes; its efficiency may be increased by first saturating the paper with fluid extract of belladonna, but in such cases great caution is required to avoid producing poisonous effects from this combination.

CERATA.—Cerates are unctuous preparations similar to ointments, but as they contain a considerable proportion of wax they are of a much firmer consistence. Like **ointments**, they are intended for external use, and, as they do not melt at ordinary temperatures, they may be spread upon linen, leather, or other substance, and applied to the skin. Simple cerate is prepared by fusing together thirty parts of white wax and seventy parts of lard; care is necessary in the selection of oils or lard for these preparations, owing to the impurities found in them, although it is said the cerates made with yellow wax show less tendency to **become rancid**. They are prepared either by fusion or incorporation, and liquefaction should be effected by gentle heat, preferably by means of a water-bath. The product may be allowed to cool quickly without stirring, or agitation may be kept up. The pharmacopœia recognizes the following, eight in number:—

Camphor.	Cerate (simple).	Savine.
Cantharides.	Lead subacetate.	Spermaceti.
Cantharides extract.	Resin.	

COLLODIUM.—Collodion is prepared by the use of pyroxylin as a base, to which alcohol in certain proportion is added, and after being allowed to stand for a period of fifteen minutes ether is added and the mixture shaken until the pyroxylin is dissolved. It is then placed in a bottle and tightly corked, when the sediment can be removed by decantation. Collodion is a transparent, colorless liquid, of syrupy consistence, having an ethereal odor, and when applied to a dry surface like the skin evaporation takes place, leaving a transparent film which possesses adhesive and contractile properties. **Flexible** collodion contains 5 per cent. of Canada turpentine and 3 per cent. of castor-oil. **Styptic** collodion contains 20 per cent. of tannic acid. There are four preparations:—

Collodion.	Collodion (flexible).
Collodion (cantharidal).	Collodion (styptic).

Iodized collodion has been suggested with a view to obtain the effect of iodine on tumors; **ferruginous** collodion has also been proposed as a local remedy in erysipelas; **caustic** collodion may be prepared by dissolving in it corrosive sublimate, one part to seven; **iodoform** collodion may be prepared in the strength of one in fifteen, by first reducing the iodoform to a fine powder.

CONFECTIONES.—Confections include those preparations having a semi-solid form, in which drugs, generally dry, are incorporated with syrup, sugar, or honey, either for preservation or for convenience in administration. The names **conserves** and **electuaries** have been abandoned. Although a number of these preparations may be used, only two are recognized:—

Confection of rose.	Confection of senna.

DECOCTA.—Decoctions are prepared by boiling vegetable substances in water for the purpose of obtaining their active ingredients, but owing to the fact that very few such bodies can be safely exposed to this degree of heat, these preparations are now less popular than formerly. Ordinary decoctions, unless specially ordered by the physician, are prepared in the proportion of one part to nine of water. There are but two:—

Cetraria (Iceland moss).	Sarsaparilla.

Other decoctions may be mentioned as follows: Cinchona, pomegranate, logwood, barley, pareira, oak-bark, broom, taraxacum, digitalis, dulcamara (bitter-sweet).

ELIXIRA.—Elixirs are palatable medicinal preparations containing the medicament for administration in small doses. The only official elixir recognized is the elixir of orange (elixir aurantii), although a large number of unofficial preparations, called elixirs, are employed in medicine. The elixir of orange is used principally as an acceptable excipient or menstruum for other drugs.

EMPLASTRA.—Plasters are used either for support, or for the purpose of local medication, or for their revulsive effect. The medicament is incorporated with a suitable adhesive base called the *plaster mass*, generally a compound of fatty substances, the whole being spread upon linen, leather, or other material. Plasters may conveniently be permitted to supercede cerates, and their extensive use and general application warrants a more extended notice of their therapeutics, which will be found elsewhere.

ENEMATA.—Enemas, injections, clysters are names of preparations intended for introduction into the lower bowel, by which local or constitutional effects may be produced. Locally, enemata may act as a

sedative, as a purgative, either direct or from reflex influences; large quantities of liquid so used may serve to cleanse the bowel, by acting mechanically, or a similar saline solution may be substituted for transfusion in case of extraordinary hæmorrhage. Nutritive or stimulant enemata in the case of disordered digestion, in wasting diseases, and in depression from shock are invaluable, and will therefore consist of liquids, as peptonized food, alcoholic stimulants, or gases, as oxygen, or enemata may be adopted in a general way for the purpose of alimentation or medication. (See Alimentation.)

EXTRACTA.—Extracts are preparations made from vegetable substances, either by evaporating the expressed juice, or from the soluble constituents thereof. They are either solid or fluid; the latter are prepared by maceration, percolation, and evaporation, but, in addition to this, for the solid extract evaporation must be continued to dryness. There are a large number of both classes recognized by the pharmacopœia,—too many, in fact, to warrant their reproduction in this section.

The **menstruum** used in their preparation is determined by the character of the drug itself; all of them require alcohol for their preservation, although for securing these soluble constituents alcohol is not always necessary. Glycerin is also used, so is water and dilute alcohol, as well as the rectified spirit; fluid extracts are practically **concentrated tinctures,** and should possess, in the finished state, a definite and uniform strength; but this will vary from time to time, depending on the quality of the preparations used. The pharmacopœia provides that one minim of each fluid extract shall represent a definite portion of the active constituents of the drug.

Extracts are of various kinds, to which brief reference is made as follows: **Green extracts** are prepared from the juice of the bruised plant heated to coagulate the coloring matter, and further heated to coagulate the albumin, when it is evaporated to the consistency of a syrup; the coloring matter is then sifted and returned, and the product further concentrated by evaporation until the requisite strength is obtained. **Fresh extracts** are prepared in a similar manner; in the absence of any coloring matter the albumin is coagulated by heat, filtered out, and evaporation conducted as before; **Aqueous extracts** are prepared by the use of water and subsequent evaporation; **Alcoholic extracts** are prepared by the use of dilute alcohol and water, by maceration, percolation of dry drugs, and subsequent evaporation. **Ethereal extracts** are variously prepared; percolation may be conducted with ether as a menstruum; by the use of ether upon an alcoholic extract; by the use of ether before making an alcoholic or aqueous extract. **Acetic extracts** are prepared like fresh extracts, acetic acid being added before expression, and evaporation arrested

while the mass is soft. **Liquid extracts** are prepared by macerating in water, evaporation, and the addition of alcohol to prevent decomposition.

Assayed extracts are prepared by determining the alkaloidal strength of the substance from which the fluid extract is to be made, as well as that of the finished product. The **alkaloidal strength** of the fluid extract, according to the pharmacopœia, may vary, a minimum and maximum limit being named, but assayed products will always be **definite and uniform** in alkaloidal purity. Thus, the fluid extract of belladonna may contain .25 per cent. to .45 per cent. of atropine, depending upon the quality of the drug used. To remedy this defect in our pharmacopœial preparations, Parke, Davis & Co. have introduced to the notice of the profession a series of fluid extracts called **Normal Liquids,** which are tested for alkaloidal purity at different stages of their manipulation, and in the case of belladonna, just mentioned, the alkaloidal strength has been fixed at .4 per cent., so that uniform dosage, in the absence of idiosyncrasies, will produce certain physiological effects. The Normal Liquids thus prepared include aconite, veratrum viride, belladonna (root or leaves), cannabis indica, cinchona calisaya, cinchona rubrum, colchicum (root or seed), conium, ergot, digitalis, gelsemium, hyoscyamus, ipecacuanha, podophyllum, nux vomica, rhubarb, and stramonium (seed or leaves). Of these preparations, one cubic centimetre is equivalent to one gramme of the corresponding drug of assayed alkaloidal purity.

The practice of **making tinctures,** syrups, and infusions from fluid extracts is often attended with injurious effects upon the substance so used, although manufacturing chemists frequently give directions on their labels for making other preparations from their fluid extracts. In prescribing, therefore, where the physician may entertain doubts as to the utility of these extemporaneous products, he should direct their manufacture in the usual manner, in conformity with the formula provided in the pharmacopœia.

GLYCERITA.—Glycerites are preparations of medicinal substances in combination with glycerin, and are convenient for the dispensing pharmacist on account of not precipitating the active constituents when diluted with water or alcohol. In the last edition of the pharmacopœia, however, all were eliminated except two.

INFUSA.—Infusions are watery preparations of vegetable substances, the water used varying from the boiling-point to cold; they are generally allowed to stand an hour or less, and strained. When not specially ordered by the physician, infusions should be prepared in accordance with the pharmacopœial formula, viz., ten parts of the coarsely comminuted substance and boiling water one hundred parts. Cold water may be used where the active principle is volatile, but prolonged heat is liable

to be attended with injury to the drug. Calumba and quassia are both prepared with cold water; infusion of digitalis is the most important, the strength of which is 4 per cent., and contains sufficient alcohol to prevent decomposition. Owing to the tendency to undergo **destructive changes** infusions should be freshly prepared as required. Infusions should not be made from tinctures and fluid extracts where the active principle is of a resinous character. The official list includes the following:—

Brayera.	Digitalis.	Wild cherry.
Cinchona.	Senna (comp.).	

In addition to the foregoing list of infusions, the following may be mentioned on account of their general use and utility:—

Bearberry.	Cusparia.	Orange-peel.
Buchu.	Ergot.	Rhatany.
Cascarilla.	Gentian (comp.).	Rhubarb.
Catechu.	Hop.	Roses (acid).
Chamomile.	Jaborandi (Pilocarpus).	Senega.
Chiretta.	Linseed.	Serpentaria.
Cloves.	Matico.	Valerian.

INJECTIO-HYPODERMATICA.—Hypodermatic medication by means of injections is now a recognized therapeutical resource, and the preparations for this purpose should receive especial care, to avoid impurities and septic influences, and the dangers of contagion, and only the best and most reliable preparations are to be adopted for this practice. The importance of the subject is deemed of sufficient interest to warrant a separate article, to which the reader is referred.

LINIMENTA.—Liniments are liquid preparations, variously composed of alcoholic liquids or fatty oils, and contain substances in solution for application to the skin by means of friction, or by simply painting, as in the case of iodine liniment. The following are recognized:—

Ammonia.	Chloroform.	Mustard (comp.).
Belladonna.	Lead (subacetate).	Soap.
Camphor.	Lime.	Turpentine.
Cantharides.		

The following are also useful preparations:—

Aconite.	Iodine.	Opium.
Croton-oil.	Mercury.	Potassium iodide and Soap.

LIQUORES.—Liquors are aqueous solutions prepared without sugar, in which the substance to be acted upon is wholly soluble in water. They may be either simple aqueous solutions or chemical aqueous solutions. Solution of **gutta percha** is prepared by the action of chloroform. There

are twenty-eight official solutions, eleven being simple and sixteen chemical, besides the gutta-percha solution, but, as they are all referred to under the appropriate headings, space is not taken up here with the list.

MASSA.—Masses are stock preparations, prepared for convenience in making pills. Three are official:—

Copaiba.	Carbonate of iron.	Mercury.

MELLITA.—Honeys differ from syrups simply in respect to the base, honey being used instead of sugar. Three are official:—

Honey.	Honey clarified.	Honey of rose.

Honey of borax is a domestic remedy which may be prepared extemporaneously.

MISTURÆ.—A mixture in pharmacy is the name given to those preparations ordered by the physician which contain insoluble substances held in suspension by the use of sugar, gum arabic, or similar substance, and are therefore to be distinguished from emulsions. Quinine may be ordered by the physician in the form of a mixture, and find that it has been dispensed as a solution. A convenient method of dispensing quinine in the form of a mixture is to add to the sulphate aromatic syrup of yerba santa, or syrup of coffee. Directions should be given to shake the bottle. Acid solutions of quinine, perfectly clear, may be prescribed, or the same result may be obtained by the use of tinctures, spirits, with glycerin, or syrup and water; but, when the physician does not know himself, the exact proportions should be left to the pharmacist. Salicylates are not to be prescribed with quinine, but, as both are frequently demanded by a patient, they should be administered separately. Mixtures generally are unstable preparations, and should not be long kept in stock. The following eleven are recognized:—

Almond.	Chloroform.	Magnesia and Asafœtida.
Ammonia.	Iron and Ammon. acetate.	Potassium citrate.
Asafœtida.	Iron (comp.).	Rhubarb and Soda.
Chalk.	Liquorice (comp.).	

MUCILAGINES.—Mucilages are watery solutions, either hot or cold, of gums or similar substances, and may be used as excipients, or for their therapeutic value, as when medicinal properties are extracted from plants. There are five in number:—

Acacia.	Quince-seed.	Tragacanth.
Elm.	Sassafras-pith.	

Mucilage of starch forms an excellent vehicle for the exhibition of remedies by enema.

OLEATA.—Oleates, as now manufactured, are true chemical preparations, containing a definite proportion of an alkaloid, or other active substance, in combination with oleic acid. These preparations are all made by means of the neutral solution of sodium oleate. Oleates are used for their local action, and do not penetrate the tissues, but the active principles they hold in solution enable us to make use of them when the ordinary ointments would be of little or no value. As the oleates have special indications for use in the treatment of various skin diseases, their preparation and therapy will be discussed under the respective headings.*

The following-named oleates are now in general use:—

Aluminium.	Iron.	Silver.
Arsenic.	Lead.	Sodium.
Bismuth.	Mercuric and Mercurous.	Tin.
Cadmium.	Nickel.	Zinc.
Copper.	Quinine.	Oleates of alkaloids.

OLEA.—There are numerous **oils** used in medicine. Thus, we have oleum phosphoratum, which is a solution of phosphorus in a fixed oil, while oleum eucalypti is distilled from the fresh leaves. There are substantially **two classes** of oils—the **fixed oils,** or those obtained by expression, and the **volatile oils,** obtained by distillation. The dose of the oils generally ranges from one to five drops, as in the case of cloves and nutmeg, and others of a similar character, but some must be used with great care. Oil of mustard is an active poison, and should be used internally with caution, and the same applies to croton-oil. Castor-oil and cod-liver oil can be taken in considerable quantities without danger.

The **fixed oils** are divided into different **groups,** as follows: Vegetable non-drying oils, as the olive-oil group. An intermediate group between that and the vegetable drying oils, comprising the linseed-oil group, is the cotton-seed oil group. Castor-oil and croton-oil form a separate division. There are two groups of solid **vegetable fats,** viz., the palm-oil group and the cocoa-nut oil group, the former including solid fats not containing glycerides of lower fatty acids in large proportion, while the latter group does contain such glycerides in notable quantity. The **animal oleins** are included in the lard-oil group, the solid **animal fats** in the tallow group, while the **marine animal oils** are included in the whale-oil group. In addition to these, we have a **sperm-oil** group, liquid **waxes,** and a **spermaceti** group,—waxes proper.

Volatile oils are variously called distilled oils and essential oils, the former having reference to their method of preparation, the latter name

* For further information in condensed form, see "The Oleates and Ointments in Diseases of the Skin," by John V. Shoemaker, A.M., M.D., Philadelphia, 1889.

conveying the idea that such products contain in a concentrated form the active properties of the substances from which they are derived. These oils are mostly **derived from plants,** and will properly be considered under their respective headings, although a word may be added to the effect that they can be administered in substance by dropping upon a lump of sugar, or made into emulsions after trituration with sugar, or after being dissolved in a small quantity of oil of almond.

ESSENCES are volatile oils kept in solution with alcohol.

OLEORESINA.—Oleoresins are prepared by the evaporation of ethereal tinctures, and do not require the presence of alcohol for their preservation, although until 1880 they were classed as fluid extracts. As the name implies, they are composed of oil (fixed or volatile) and resin, and probably other active constituents, according to the source from whence obtained. The ether employed in this process is recovered by distillation, except toward the close, when that remaining is allowed to evaporate spontaneously to avoid impairment of the volatile product. Of these preparations there are six:—

Aspidium.	Cubebs.	Lupulin.
Capsicum.	Ginger.	Pepper (black).

PILULÆ.—Pills are small globular bodies containing medicaments for administration, to be swallowed by the patient. Certain pharmacopœial directions are given for their preparation, both the ingredients and the excipient being specified, but in extemporaneous pharmacy are ordered by the physician, and he may order the excipient also, or leave that to the judgment of the druggist.

Within the past few years the manufacture of pills has become an important industry, and doubtless abuses have crept into medical practice by reason of the inferior quality of the ingredients, and, on the other hand, the physician has often been loth to send his prescriptions to the local pharmacist to be prepared by an inexperienced and overworked boy. Hence, the suggestion is appropriate and timely that physicians should endeavor to determine the character of the pills ordered, by observing their appearance and noting their action upon the patient, and by investigating their solubility; if coated, the latter is especially necessary, as the authors have frequently found these ready-made pills practically insoluble. Glue, or some similar material, appears to enter into the composition of the coating of some, although in others the coating is scarcely perceptible, and every precaution seems to have had attention with a view to enable the physician to secure the best results. **Compressed pills,** being made without any excipient whatever, theoretically, are far superior to all others, but they have the disadvantage that the taste is not fully covered, and, besides, the force necessary to prevent

their disintegration is such that they are not readily soluble in the gastric juice, but their place is well supplied by the introduction of triturates (q. v.).

The number of official pills is fifteen, but as the composition of each is given under the proper heading the list is omitted here.

PULVERES.—Powders are finely divided medicinal substances usually prepared for internal administration, and when so used they should be given in small doses, and only those substances which are free from objectionable features in respect to taste and local action upon the tissues. Deliquescent preparations are unsuited for dispensing in this form, and, as all substances of this character are subject to change from exposure to light and air, they should invariably be kept in well-stoppered bottles coated with black varnish. Powders are either simple or compound, and when two or more ingredients are to be dispensed together it may be necessary that they should be pulverized separately, and great care is required to secure perfect distribution of the ingredients, that the patient may not take a large quantity of powerful medicine at one dose which was intended for distribution into several doses. There are nine official powders, viz. :—

Antimony.	Effervescent (comp.)	Liquorice (comp.)
Aromatic.	Ipecac and opium.	Morphine (comp.)
Chalk (comp.)	Jalap (comp.)	Rhubarb (comp.)

RESINA.—Resins are solid substances obtained from alcoholic solutions of plants by the action of water; as compared with fluid extracts, they contain only the resinous principles which are insoluble in water, while all those principles soluble in alcohol are to be found in extracts.

To avoid mistakes it should be mentioned that these resinous precipitates are not proximate principles, nor should they be relied upon as containing the active constituents of the plants with whose names they are associated. They should be regarded simply as impure resins, which may or may not contain a portion of the active principle of the plant, and caution is required that those substances now found upon the market with the termination **in** should not be confounded with true alkaloids having the termination **ine,** nor with glucosides, with the same termination **in.** The following four resins are official :—

Copaiba.	Podophyllum.
Jalap.	Scammony.

SPIRITUS.—Spirits are alcoholic solutions of volatile substances, prepared either by distillation or by simple solution. In preparing spirits it is important to have the alcohol carefully rectified, when it may be diluted with water, and care is also required to avoid the color and flavor of empyreumatic decomposition. Aromatics should first be macerated in

water before distillation. Twenty-two preparations are recognized, but their importance is not deemed sufficient to warrant the reproduction of the list here, and they will be found in the proper place.

SUPPOSITORIA.—Suppositories are specially shaped, somewhat plastic medical preparations ordered by the physician, and are intended for local application to the rectum, the vagina, or the urethra. The pharmacopœia prescribes a general formula for their preparation, in which cacao-butter is incorporated as an excipient for the medicinal substance at a temperature sufficiently elevated to enable the mixture to be poured into suitable molds while cooling. It may be added that in the absence of the necessary facilities, and want of time for making such preparations, the use of gelatin capsules as containers will be found equally efficient. Manufacturing chemists have anticipated this demand on the part of the profession by preparing and keeping in stock a full line of suppositories suitable for nearly all classes of affections.

SYRUPI.—Syrups are prepared by the solution of sugar in water; the pharmacopœia provides that five pounds of refined sugar shall be dissolved in two pints of distilled water by the aid of heat, and after cooling a sufficient quantity of distilled water is to be added to make the weight of the product up to seven and one-half pounds, with a specific gravity of 1.330 (59° F.). There are thirty-four official syrups.

Syrups are termed either **simple, medicated,** or **flavored,** and are variously used as excipients, but the objections to them are serious, and relate to their lack of permanency, as fermentation is liable to take place, when they are no longer suitable for dispensing purposes. Much depends upon the relative proportion of sugar and water they contain, and the attention which the sealing of the corks has received.

SUCCI.—Juices are obtained from fresh plants by expression and the addition of one-third of their bulk of alcohol for preservation, and although used by many practitioners they are not recognized in the present issue of the pharmacopœia. They have long been accorded a place in the British Pharmacopœia, and are very generally used abroad, although, considering the various factors which enter into their preparation liable to affect their virtues, it is doubtful if their activity is to be depended upon. They are sometimes called preserved vegetable juices. The following juices have been recommended:—

Belladonna.	Dandelion.	Henbane.
Broom.	Hemlock.	

TINCTURA.—Tinctures are alcoholic solutions of medicinal substances chiefly made from non-volatile vegetable bodies. Their method of preparation includes comminution, maceration, percolation, and pressure, to be followed by filtration. Tincture of iodine is the only official

exception, all others being of vegetable origin. Ammonia and ether are also used in the preparation of tinctures, such products being distinguished as **ammoniated** tinctures and **ethereal** tinctures.

A general formula is given in the pharmacopœia for the preparation of **tinctures of fresh herbs,** as follows: Fifty parts of the fresh herb bruised or crushed, to be macerated with one hundred parts of alcohol for the period of fourteen days, when it is to be subjected to expression and the product filtered. In connection with the foregoing, it should be noted that manufacturing chemists have been unfortunate in their attempts to prepare reliable tinctures from the fresh drugs, and in a communication to the authors a representative of one of the most extensive manufacturing houses in this country asserts that liquid preparations from the fresh drug do not fully represent the properties of that drug where those properties depend upon the presence of an alkaloid, glucoside, or other similar principle as other preparations manufactured from the properly cured herb. As an instance we are cited the use of aconite (leaves and root), belladonna, digitalis, and other drugs in the dried form for the manufacture of alkaloids, and the reasonable claim is made that if there were anything in the idea that proper drying or curing tends to the decomposition of the active principles, manufacturers, with due regard to economy and result, would abandon the attempt to manufacture for sale such principles from the dry drug. It is urged that the fresh plant always contains elements of decomposition, sure to be retained in liquid preparations, which tend toward chemical changes or inelegant preparations unless a sufficient quantity of alcohol is added; it is further claimed that the successful promoters of fresh herb tinctures do not prepare these tinctures in accordance with the published formulæ.

Of course, where the properties depend upon the presence of a volatile principle which is lost or destroyed by drying, it will be necessary in such cases to prepare the tincture from the fresh plant, but all volatile substances do not lose their activity by drying and powdering.

TRITURATIONES.—Triturations are prepared according to the pharmacopœial formula in the proportion of ten parts of the drug to ninety parts of sugar of milk, the medicinal substance being first reduced to a fine powder, to which is added about an equal part of sugar of milk and trituration begun, adding sugar of milk from time to time until the entire amount is used. The above general formula has been introduced evidently with a view to have some definite plan followed by physicians and pharmacists, although practically but little attention is paid to it. Triturations as generally prepared contain the medicament, either an alkaloid or one of its salts, a glucoside, a resin, an evaporated fluid extract or

tincture, in minute doses, each triturate carrying a specified amount of the preparation, and as a rule these triturates vary in weight from one to two grains. When necessary, for the purpose of making them more stable, and yet not affecting their solubility, a small quantity of grape-sugar is added. Triturations thus prepared may be either **simple or compound**; that is, they may contain but a single medicinal substance or they may contain two or more, and, being made by machinery, they may be simply triturated and divided, or they may be compressed.

The method of **treating disease** by the administration of medicines prepared in this manner possesses many **excellent features**, among which may be mentioned the concentration and reliability of the medicaments supplied; their palatableness, conjoined with the certainty of ready solution in the stomach juices, are features which commend them strongly to the attention of physicians, as they can be administered with equal satisfaction to both **adults and children.** The same rules apply to the manufacture of triturates which govern the pharmacist in the preparation of pills, but the thorough comminution of a medicinal substance in the form of a triturate renders the latter far superior to the former in certainty in the effect to be produced, and requires but a **fractional portion** of the drug to produce an effect equal to that of the former. This is not a mere fancy on the part of those who have been accustomed to the use of these preparations, but will be evident to the most obtuse observer, the explanation of which may be found in the method of preparation, by which the substances employed are subjected to a more thorough subdivision, by which a larger proportion of the drug is utilized, leaving a comparatively small portion to cause local irritation when taken into the stomach. The **best illustration** which can be given of this feature is seen in the preparation of calomel triturates, the crude material being subjected to comminution in such a degree that comparatively **small doses** may be expected to accomplish results equal to that formerly secured by the administration of massive doses, and, besides, the dangers of ptyalism are avoided. So **popular** are these preparations with physicians, not alone in the thickly inhabited sections, but in the more sparsely settled portions in the country, where physicians often find difficulty in obtaining suitable medicinal preparations, that a **demand** has been created for them sufficient to warrant a well-known manufacturing firm in placing upon the market over two hundred such preparations.

TROCHISCI.—Troches, tablets, or **pastilles** are really compressed pills, containing certain medicaments with a view to effect special therapeutical results, and are prepared in great variety. These preparations are generally sold by druggists to the laity, many of whom constantly use them for self-medication, and undoubtedly, in many instances, **serious**

results have followed their indiscriminate use. Tablets of Dover's powders have created a taste for the effects of opium; cocaine tablets have deranged nutrition and injuriously affected the nervous system; pepsin tablets, in combination with other remedies, frequently pave the way for prolonged attacks of illness, while to the illegitimate use of potassium chlorate may be traced with a reasonable degree of certainty the prevailing tendency in modern civilization to the development of Bright's disease and other affections of the kidney. The abuse of quinine prepared in palatable form, such as tablets and troches, has but lately come within the observation of the physician, and the whole tendency of **medicine-tippling,** as promoted and practiced through the enterprise of venal manufacturers with the connivance of friendly and avaricious druggists, may be summed up in a single word, "**abominable.**" There are sixteen official troches.

UNGUENTA.—Ointments are fatty substances, similar to cerates, but softer, and are of a consistency suitable for application to the skin by inunction. The base is lard, petrolatum, or a fixed oil, and they are prepared by combining the medicinal agents by incorporation, by fusion, or by chemical reaction. In the use of lard for these products some precautions are necessary to avoid **septic influences,** and the pharmacopœia recommends the use of benzoinated lard. A new base, **lanolin,** has lately been introduced to the notice of the profession, which it is claimed offers greater facilities in the use of ointments, especially where they are to be applied to a moist surface. Organic and vegetable oils do not **absorb moisture,** animal oils do so but sparingly, while lanolin, which is prepared from wool-fat, will absorb more than half its weight in moisture, thus permitting the medicinal substances incorporated with it to reach the affected tissues more readily. There are twenty-six official ointments.

VINA.—Wines are either medicated or unmedicated, the latter being substantially the same as tinctures, in which white wine is used as a menstruum. The official list of wines includes fourteen varieties, all of which are medicated except three. Medicated wines contain a certain percentage of the active ingredient used in their preparation, which varies from 0.4 per cent. in wine of antimony to 40 per cent., the strength of wine of colchicum root.

In concluding this sketch of the more important operations and preparations of pharmacy, it should be mentioned that the authors had intended to include in this section various details relating to **extemporaneous pharmacy,** and had accumulated considerable material in the shape of notes for the purpose, but after due consideration the project was abandoned for the following reasons: The information may be obtained in works devoted exclusively to this branch in more complete form than could be given it in these pages, and to such works students and practi-

tioners wishing to enter upon the study are referred. A still more urgent reason lies in the fact that the work is not announced as a treatise upon **pharmacy,** but rather upon **therapeutics,** and much that might be added to the foregoing would be regarded as of trifling value. It has been deemed expedient, however, to add tables of weights and measures and some data connected with the metric system, which may be of interest. A selected list of the more common abbreviations in use will be found in connection with the subject of prescription-writing.

WEIGHTS AND MEASURES.

All formulæ given in the pharmacopœia are constructed upon the system of parts by weight, whether fluids or solids, except fluid extracts, for which the **metric system** has been adopted. As a rule, however, the physicians of this country have shown a disposition to cling to the Apothecaries' or Troy weight, notwithstanding the fact that the metric system has been adopted as the standard in the last revision of the pharmacopœia.

Apothecaries' Weight.

20 grains (gr.)	make 1 scruple (℈j)	
3 scruples	make 1 drachm (ʒj)	= gr. 60
8 drachms	make 1 ounce (℥j)	= gr. 480
12 ounces	make 1 pound (lb.)	= gr. 5760

Apothecaries' Measure.

60 minims (♏)	make 1 fluidrachm	(fʒj)
8 fluidrachms	make 1 fluidounce	(f℥j)
16 fluidounces	make 1 pint	(Oj)
8 pints	make 1 gallon	(Cj)

To reduce the above weights and measures to metric terms, it is only necessary to multiply grains and minims by six and a half, the product will be the expression in centigrammes; drachms multiplied by four give the metric result as so many grammes; and, to reduce ounces to grammes, the amount in ounces should be multiplied by thirty-two.

Thus, 1 grain or 1 minim is approximately . . . 6.5 centigrammes;
1 drachm or 60 minims is approximately . . 4 grammes.

Example: 20 grains equal 130 centigrammes; expressed, 1.30. 5 drachms equal 20 grammes; expressed, 20.

Reversing the proposition, we find that:—

1 centigramme (.01) is approximately 1 grain or 1 minim divided by 6½, or about ⅙ of a grain, or ⅙ of a minim.

1 gramme is 100 times as much as 1 centigramme, or ¼ of one drachm, approximately 15 grains, or 15 minims; to reduce grains to grammes divide by 15.

1 gramme is $\frac{1}{32}$ of an ounce; hence to reduce grammes to ounces we divide by 32.

Example: 90 centigrammes (.90) equal approximately 14 grains; but for practical purposes 15 grains will do as well; 10 grammes (10.) equal approximately 2½ drachms.

The table of metric and apothecaries' equivalents will then be as follows :—

1 centigramme (.01)	equals ⅙ grain or minim;
1 gramme (1.)	equals 15 grains or minims;
1 milligramme (.001) . . .	equals $\frac{1}{65}$ grain or minim.

Reversing the table, we have :—

1 grain equals 6.5 centigrammes, or 65 milligrammes.

It will thus be seen that with a little study and care the subject of weights and measures may be mastered.

Avoirdupois Weight.

The pound avoirdupois contains 7000 grains, which is 1240 grains more than the troy pound, but the ounce contains a less number of grains, the grain being the unit of measure or weight.

Avoirdupois pound, grains 7000; ounce, grains 437.5.
Troy pound, . . grains 5760; ounce, grains 480.

Approximate Measures.

1 minim			varies from one to two drops.
1 fluidrachm	=	(about)	1 teaspoonful.
2 fluidrachms	=	"	1 dessertspoonful.
½ fluidounce	=	"	1 tablespoonful.
2 fluidounces	=	"	1 wine-glassful.
4 fluidounces	=	"	1 teacupful.

Table for Apportioning Doses.

21 years of age, ...	full dose.
14 " "	⅔ "
12 " "	½ "
6 " "	⅓ "
1 year of age, ...	$\frac{1}{12}$ "
3 months of age, ...	$\frac{1}{20}$ "

French Weights and Measures.

WEIGHT.

1 gramme . . .	=	15.434 grains.
1 decigramme . .	=	1.5434 grains.
1 centigramme . .	=	.15434 grain; approximately, ⅙ grain.
1 milligramme . .	=	.015434 grain; approximately, $\frac{1}{65}$ grain.
1 decagramme . .	=	154.340 grains.
1 hectogramme . .	=	1,543.402 grains.

LENGTH.

1 metre	= 39.368 inches.
1 decimetre	= 3.9368 inches.
1 centimetre	= .39368 of an inch.
1 millimetre	= .039368 of an inch.
1 decametre	= 393.68 inches.
1 hectometre	= 3,936.8 inches.
1 kilometre	= 39,368. inches.
1 myriametre	= 393,680. inches.

MEASURE.

1 litre	= 2.095 pints,	or 15,434 grains.
1 decilitre	= 3.215 f℥,	or 1,543.4 grains.
1 centilitre	= 2.572 fℨ,	or 154.34 grains.
1 millilitre	= 16.231 ♏,	or 15.434 grains.
1 decalitre	= 2.641 C,	or 154.340 grains.
1 hectolitre	= 26.419 C,	or 1,543,400 grains.
1 kilolitre	= 264.19 C.	
1 myrialitre	= 2,641.9 C.	

PHARMACOLOGY.

GENERAL CONSIDERATIONS.—The magnitude of the task assumed in attempting to decide upon a **Classification of Medicines** can only be appreciated by those who have themselves essayed a like undertaking. Even the work of classifying the physiological action and therapeutical indications of almost any common and well-known remedy is frequently attended with lapses and complications that are often exceedingly unsatisfactory. A drug which in one sense may be regarded as possessing **restorative properties,** when studied from some other standpoint furnishes the best evidence of its being well adapted to promote **destructive metamorphosis.** What, then, shall we accomplish in the effort to class a considerable number of preparations as belonging to the same group? The manifest inappropriateness of such methods is but too apparent to modern therapeutists, and the only excuse for such procedure is advanced in the form of a reason, which has more or less force, depending upon the disposition of the writer to confine his investigations within self-constituted grooves of thought. This reason may be stated in a few words, viz: A classification is **practically a necessity,** in order to advance our scientific knowledge, and, however artificial it may appear, no other method is so well calculated to further the object in view. In compliance with these premises, we have had a multitude of theories, covering every conceivable application of ancient and modern discovery, and still the lack of completeness in respect to system is even more prominent than it was in the time of Cullen.

By the adoption of an **alphabetical nomenclature,** all attempts at

classification must be discarded, but this method, while convenient for reference, is fatal to any advantages resulting from associating one drug with others of a like character, either with a view to their combination, or for the purpose of substituting one for the other, and is decidedly objectionable to those who may desire to conduct their inquiries in certain channels. The physician, at a loss for remedies which act as evacuants, will naturally turn to laxatives, or purgatives, simple, hydragogue, cholagogue, or saline, and by a study of their different effects will be materially aided in selecting suitable measures for the relief of his patient. While recognizing, therefore, the artificial character of classifications in general, the following not excepted, the authors have endeavored to so collate the information upon **pharmacology** in the body of the work that each observation will not only stand alone as an entirety, but will be in intimate relation with other investigations, and with **therapeutics,** the main object of the work.

If the pictures of ten or one hundred persons were subjected to the process known as **composite photography,** each defect in the different faces, as well as individual characteristics, would be reproduced in proportion to their extent, and would be more or less apparent in accordance with the number included in the operation. Under the respective headings of the different drugs an attempt has been made to distribute accumulated knowledge and experience in such a manner that it will in a measure furnish a reflected picture of its therapy, substantially a **composite mental photograph,** and it is believed that those who honor this work by consulting it will not find this an impossible, or even difficult, undertaking.

The classification finally decided upon is largely that of Garrod, who has long occupied a foremost position as an author and teacher, modified to some extent by the discoveries and teachings of Brunton, so well known as an indefatigable worker and faithful observer in pharmacology, and it is hoped that, in connection with the alphabetical arrangement that has been adopted, much benefit will be derived from its consultation and study. With a view to further simplify the study for beginners, a note has been added, covering the various subdivisions, in a general way referring to the pharmacological and therapeutical relations and applications, without entering into details regarding the special drugs, which are more conveniently considered in their proper order.

Medicines may be divided into **three general classes**; those for **internal administration,** those for **external application,** and a third class, embracing **antidotes, disinfectants,** and **antiseptics,** the accompanying diagram indicating more particularly the plan of distribution of the various remedial agents :—

Classification of Medicines.

- **Internal Remedies.**
  - **Medicines Affecting Nutrition.**
    - Blood tonics (hæmatinics).
    - Alkalies.
    - Acids and Astringents.
    - Refrigerants.
    - Antipyretics.
    - Alteratives.
  - **Medicines Acting through the Nervous System.**
    - The Brain.
      - Exhilarants.
      - Narcotics, Soporifics, and Anodynes.
      - Anæsthetics.
    - Spinal Cord.
      - Stimulants.
      - Sedatives.
    - Nerve-Centres and Ganglionic System.
      - Antispasmodics.
      - Nervine tonics and
      - Antiperiodics.
    - Heart and Circulatory System.
      - Vascular stimulants.
      - Vascular sedatives.
      - Vascular tonics.
    - Special Organs.
      - Alimentary Canal.
        - Sialagogues.
        - Emetics.
        - Purgatives.
        - Anthelmintics.
        - Stomachics.
      - The Liver.
        - Hepatic stimulants.
        - Hepatic sedatives.
      - Respiratory Apparatus.
        - Errhines.
        - Expectorants (pulm. stim.)
        - Pulmonary sedatives.
      - Cutaneous System.
        - Sudorifics and Diaphoretics.
      - Urinary System.
        - Diuretics.
        - Lithontriptics.
        - Mucous stimulants,
        - Sedatives.
      - Generative System.
        - Emmenagogues,
        - Ecbolics.
        - (Galactagogues.)
        - Aphrodisiacs.
        - Anaphrodisiacs.
      - The Eyes.
        - Mydriatics.
        - Myotics.
- **External Remedies.**
  - Irritants.
    - Rubefacients.
    - Epispastics or blistering agents.
    - Pustulants.
  - Sedatives.
  - Emollients.
  - Astringents and Styptics.
  - Antiparasitics.
  - Caustics and Escharotics.
- **Chemical Agents.**
  - Antidotes.
  - Disinfectants and Antiseptics.

MEDICINES AFFECTING NUTRITION.—The first group in the foregoing classification includes a series whose function is to act upon the blood, thus producing an effect upon nutrition through the changes affected in its character or composition.

Hæmatinics, or blood tonics, are remedies which are supposed to possess the power of improving the character of that fluid by restoring to it elements or principles which are lacking. The vitality and strength of the body depend upon the nutritive character of the red corpuscles and the presence of hæmoglobin, and these again depend largely upon the kind and quantity of food, the condition of the digestion, and the facility with which the excrementitious products are eliminated from day to day. Anæmia is one of the most striking illustrations of deterioration of the quality of the blood, but the **anæmia of plethora**, which is found in connection with deficient elimination of the products of tissue-change, instead of hæmatinics, will most quickly respond to those measures instituted for the purpose of overcoming **suboxidation.**

In all cases which seem to demand the administration of blood tonics it is especially necessary that a suitable dietary should be adopted, that the patient should have as much exercise as his condition will warrant, with plenty of fresh air and sunlight. No treatment will be efficient without attention to these **hygienic regulations.**

Hæmatinics.

Preparations of iron :—	Oxide and salts of manganese.
Metallic iron,	Cod-liver oil and
Compounds of iron with oxygen,	Other animal oils.
Compounds of iron with mineral acids,	Vegetable oils.
Compounds of iron with organic acids.	Cinchona and its salts.

ALKALIES AND ANTACID MEDICINES.—Alkalies are remedies which increase the normal alkalinity of the blood and affect the secretions; those which are normally alkaline are rendered more so, and those normally acid are changed to alkaline. This change being more easily accomplished than the restoration of the normal condition, alkalies should be administered with caution, although they are essential in rheumatic affections, in gout, and may be depended upon to a certain extent in digestive troubles. These remedies **affect nutrition** by increasing secretion, a point which should be borne in mind in the treatment of pulmonary affections, although alkalies should not be continued too long, but should be supplemented within a few days by the use of acids and astringents. Rossbach's experiments do not confirm clinical observations in this respect, but the discrepancy may be accounted for by reason of the larger dose used in physiological experiments. Alkalies, therefore, should be given **well diluted** and in **small doses.** This suggestion is warranted by

the observations of Brunton, who finds that both acids and alkalies in dilute solution first increase protoplasmic movements, then arrest them, causing these bodies to swell with dilatation, until finally solution takes place; contractures of muscle are variously affected, increased by some, and diminished by others, but these results are modified to some extent by the dose.

Alkalies are **direct and remote**; the former have an alkaline reaction, but the latter do not. Soda preparations more especially affect the stomach, while potassium preparations act more noticeably upon the kidney and vesical mucous surfaces; some seem to possess both properties, while others, as the citrates, the tartrates and acetates have no apparent effect upon the stomach, but when taken up by the blood are changed into carbonates, and lessen the acidity of the urine when excreted by the kidney.

The **indications** for the **use of alkalies** may be summed up thus: To neutralize the acidity of the stomach and increase the activity of the gastric juice, but in order to accomplish this result attention must be given to the **time** of their **administration**; the second indication for their administration will be found in those cases where it is desirable to increase the alkalinity of the blood, as in febrile conditions, in gout and rheumatism; a third use for alkalies may be mentioned, which refers to their influence in modifying the secretions, more especially by the selection of lithontriptics. There are, in addition to the following list, a number of purely **vegetable substances** which appear to possess the property of acting as remote alkalies by modifying the urinary secretion.

Alkaline or Antacid Medicines.

DIRECT ALKALINE REMEDIES.

Solution of caustic potash.
Carbonate of potash.
Bicarbonate of potash.
Solution of caustic soda.
Carbonate of soda.
Bicarbonate of soda.
Solution of caustic lithia.
Carbonate of lithia.
Bicarbonate of lithia in solution (lithia water).
Magnesia (calcined magnesia).
Carbonate of magnesia.
Bicarbonate of magnesia in solution (fluid magnesia).
Lime-water and strong saccharine solution of lime.
Carbonate of lime (chalk).

DIRECT, BUT NOT REMOTE.

Antacids, at least on the urine:—
Solution of ammonia,
Carbonate of ammonia,
Aromatic spirit of ammonia,
Wood charcoal,
Animal charcoal.

REMOTE ALKALINE REMEDIES.

Salts of potash with a vegetable acid, as acetate, citrate, and neutral tartrate.
Acid tartrate of potash (in small doses).
Salts of soda with a vegetable acid.
Citrate of lithia.

ACIDS AND ASTRINGENTS.—The general action of acids upon the tissues is that of an astringent; new compounds are formed, and others previously existing are destroyed, and there is an apparent loss in the fluidity of the blood. The vegetable acids are also astringents, but in a different degree, tannic and gallic acids being the most active; turpentine is a valuable astringent, taken either internally, to affect mucous surfaces, or by inhalation in certain pulmonary affections. The **general action** of acids is manifested upon the various **tissues, organs, and secretions** in a manner to indicate that the whole system may thus be reached; the secretion of the respiratory mucous membrane is lessened as well as that of the skin, although Brunton has pointed out that acids affect the capillaries in certain organs, notably the respiratory, and cause dilatation, and from this circumstance their value as stimulating expectorants becomes appreciable. Acids, when applied in concentrated form, may act as caustics; their use as antihidrotics, remedies to prevent sweating, has long been recognized, and vinegar will often be found most serviceable. In the mouth they produce a peculiar sour taste, with roughening of the teeth; in the stomach, they may be used with advantage as aids to digestion, by supplying an artificial digestive fluid; as sialagogues, they act in a reflex manner, and are supposed to possess properties which stimulate the liver and increase the flow of bile.

The **indications** for the use of acids may be thus summed up: To arrest hæmorrhage, in which there are two factors to be considered, the action of the remedy upon the blood, and the action upon the vascular system. The value of ergot in hæmorrhage from the uterus is well known, but there are frequently times when that organ fails to respond to this drug, and in such cases, a remedy acting upon the blood, like dilute nitric acid, in small but frequently repeated doses, will produce an immediate and decided effect. A second indication for acids and astringents is to restrain discharges from mucous surfaces, as the bowels and respiratory tract; a third indication which these remedies meet is that of checking excessive secretion, as from the bronchial mucous membrane, or that of the bowel, or for the purpose of correcting a deviation of this kind in the kidney. Nothing so well illustrates this latter observation as the use of ergot in the treatment of diabetes insipidus. The secretion of urine may be three or four times the normal amount, but if the disease has not continued too long, and the physical condition of the patient is fairly good, the persistent use of ergot for but a short time will be manifested by marked improvement, and perfect recovery may be looked for.

The list which follows is arranged to show some of the more important of the drugs which can be conveniently grouped according to their

character; vegetable and mineral acids along with substances containing tannin and other remedies:—

Acids and Astringents.

VEGETABLE ACIDS, AND SUBSTANCES CONTAINING THEM.

Acetic acid.	Tannic acid.
Benzoic acid.	Tartaric acid.
Citric acid.	Vinegar.
Gallic acid.	

SUBSTANCES CONTAINING TANNIC, GALLIC, CATECHUIC, OR OTHER ALLIED ACIDS.

Areca.	Matico.
Catechu.	Nut-galls.
Ergot of rye.	Oak-bark.
Eucalyptus resin.	Rhatany root.
Guarana.	Rose-leaves.
Kino.	Tea.
Logwood.	

MINERAL ACIDS.

Diluted sulphuric acid.	Acetate of zinc.
Diluted hydrochloric acid.	Sulphate of zinc.
Diluted nitric acid.	Oxide of lead.
Diluted nitro-hydrochloric acid.	Carbonate of lead.
Diluted phosphoric acid.	Acetate of lead.
Alum.	
Sulphate of iron.	
Perchloride of iron.	
Pernitrate of iron.	Oil of turpentine.
Oxide of zinc.	Carbolic acid.
Carbonate of zinc.	Creasote.

REFRIGERANTS.—Refrigerants differ from antipyretics in being used simply to allay thirst in febrile disturbances, and may be either **local** or **general.** The former are frequently useful in cases accompanied by irritability of the stomach, when liquids cannot be swallowed, but when the mouth and fauces remain dry and parched. In those cases the use of water as a wash or gargle will be found valuable, and occasionally it will be desirable to combine with it a mucilaginous substance, which acts as a covering to the mucous membrane until the more active symptoms have subsided. Oatmeal, flaxseed, milk, or other similar substance, may be added to the water for this purpose, and, when not contra-indicated by the physical condition, small doses of pilocarpus may be administered with advantage.

Nothnagel advances the theory that **general thirst** is probably dependent for its development upon the nervous system, and has located a thirst-centre in the occipital lobes—an observation which appears to be confirmed by the use of opium, which lessens the excitability of this centre and overcomes thirst. This theory, however, does not stand, if

we accept the view that opium is a stimulant, and, when given in suitable doses, increases secretion, as has been pointed out in the article upon purgatives. It is evident, as Brunton has observed, that general thirst depends upon the condition of the organism, and may be due either to the deficiency of water or excess of soluble, or especially saline, substances in the circulation. The use of mineral and other acids and effervescing drinks has long been recognized as valuable adjuncts in the treatment of fevers. Tamarind whey is made by adding four parts of the pulp to one hundred of boiling milk, straining, and filtering.

Acetic acid.	Grape-juice.	Tamarinds.
Chlorate of potash.	Lemon-juice.	Tartaric acid.
Citric acid.	Nitrate of potash.	Water and mucilaginous drinks.
Cream of tartar in solution.	Orange-juice.	
	Phosphoric acid.	

ANTIPYRETICS, OR FEBRIFUGES.—The subject of antipyretics has, within late years, received special attention at the hands of experimental physiologists, and the conclusion seems to be warranted that a centre regulating the production of heat is situated in the brain near the corpora striata, but the suggestion of Brunton should not be overlooked—that the temperature may be affected by drugs acting upon the nervous system apart from the circulation, and also by drugs which affect the tissues themselves. Lately, there have been introduced to the notice of the medical profession a considerable number of products, classed as carbon compounds, which differ essentially from those hitherto used, but, as these special preparations will be referred to in the regular order, only the general principles underlying the application of antipyretics will be referred to here.

The **object** of these remedies is to **reduce** the body **temperature** in the course of fever, and especially to control hyperpyrexia. The oxygen-carrying and ozonizing power of protoplasm is a recognized factor in maintaining the normal temperature in health. Oxidation is constantly going on, and whenever there occurs complications in the **production of heat** in the system, or its **discharge** by radiation or through the lungs, the effect is manifested by increased or diminished temperature. Some of the more recent antipyretics, like antipyrin, are believed to be useful by reason of the properties they possess of increasing the discharge of heat by affecting the peripheral vasomotor system. Thus, during the early morning, it is well known that the body temperature reaches its lowest point during the whole twenty-four hours, and it is at this period that the vasomotor system is least liable to be affected by extraneous influences. It is also a well-known fact that the temperature, even in apparent health, may vary at different periods of the day, as pointed out by Ringer.

Again, it is possible that certain drugs, as acetanilid, may modify the temperature through their **action upon the blood.** It has been shown that this remedy affects the blood by destroying the oxyhæmoglobin, converting it into methæmoglobin, by which the nutritive qualities of the red blood-corpuscles are destroyed, hence the numerous complications that have arisen from its employment. Aside from drugs, however, the circulation exercises an important influence in the discharge as well as the formation of heat. The skin is another important factor in controlling body heat, but the cases which have been reported in **surgical practice,** in which the degree of heat was far beyond anything which it is believed would be compatible with life in medical practice, is conclusive evidence of the influence of the nervous system as a factor in its production.

Ordinarily, we should have no less than four divisions of these remedies: first, those which lessen and those which increase the **production** of heat; second, those which lessen and increase the **discharge** of heat; but, as no attempt has been made to study two of these subdivisions, we have for consideration two **general classes of antipyretics,** viz., those which lessen the production of heat and those which increase the discharge of heat. The diagram on page 46 has been adapted from the excellent treatise of Brunton, and will serve an important purpose for the student in elucidating this much-contested subject.

This section will be further complemented by reference to the topics contained in the diagram, such as baths, heat and cold, counter-irritants, diaphoretics, and purgatives, etc. In conclusion, it may be remarked that **discretion** is necessary in the selection of antipyretics. **Quinine** has been found efficient in malarial fevers and in the thermal fever of tropical climates, but in acute rheumatism it is less efficient than the **salicylate of sodium. Venesection,** which was formerly regarded as a powerful antiphlogistic, is of comparatively little value in many diseases, unless the amount of blood abstracted is sufficient to endanger the physical condition of the patient. The temperature soon rises again, but experience has shown that in the incipient stage of pneumonia, in sthenic cases, bleeding, in combination with antipyretics, will prove excellent as an abortive treatment.

There is a class of vegetable remedies which may be called **vascular antipyretics,** including aconite, digitalis, veratria, gelsemium and strophanthus, which are entitled to our highest consideration, but they are of little value, and often contra-indicated in specific fevers. Remedies of this class may be exhibited with the best results in the case of vascular excitement, in the early stages of nearly all diseases, but depressing agents should not be too long continued.

Antipyretics.

- **LESSEN PRODUCTION OF HEAT.**
  - Acting on tissue-change . . . .
    - Alcohol.
    - Antipyrin.
    - Benzoic acid.
    - Berberine.
    - Camphor.
    - Carbolic acid.
    - Chinoline.
    - Cinchonidine.
    - Cinchonine.
    - Eucalyptol.
    - Hydroquinon.
    - Kairin, Kairoline.
    - Oil of winter-green.
    - Other essential oils.
    - Picric acid.
    - Phenacetin.
    - Pheno-resorcin.
    - Pyrocatechin.
    - Pyrodin.
    - Quinidine.
    - Quinine.
    - Resorcin.
    - Salicin.
    - Salicylate of methyl.
    - " " quinine.
    - " " sodium.
    - Salol.
    - Thymol.
  - Acting on the circulation.
    - Generally.
      - Aconite.
      - Antimony salts.
      - Colchicum.
      - Digitalis.
      - Gelsemium.
      - Strophanthus.
      - Thallin.
      - Trymethylamine.
      - Veratrine.
    - Locally.
      - Baunscheidtismus.
      - Blisters.
      - Dry cupping.
      - Wet cupping.
      - Leeches.
      - Poultices.
- **INCREASE DISCHARGE OF HEAT.**
  - By dilating the cutaneous vessels and increasing radiation . . . .
    - Acetanilid.
    - Alcohol.
    - Antipyrin.
    - Kairin.
    - Nitrous ether.
    - Thallin.
  - By increasing the loss of heat due to evaporation of perspiration. — Sudorifics.
    - Antimonial preparations.
    - Nitrous ether.
    - Opium and Ipecacuanha.
    - Pilocarpus.
  - By abstracting heat from the body . .
    - Cold bath.
    - " affusion.
    - " sponging.
    - Wet pack.
    - Ice to the surface.
    - " bags to the neck.
    - Cold drinks.
    - " enemata.
- **MODE OF ACTION UNCERTAIN.**
  - Purgatives.
  - Venesection.

ALTERATIVES.—The idea has long been entertained by physicians that many remedies **affect nutrition** in a manner which still remains unexplained by the physiologist. Up to a certain point we are able to indicate, with a reasonable degree of certainty, the **physiological relations** existing between disease-conditions and medication; but in the use of a considerable number of remedies the true physiological basis upon which **metabolism** depends still remains to be discovered. The different lists of remedies already discussed under various topics might with propriety be regarded as alteratives, from the fact that we are still unable to explain the changes they effect when taken up by the blood and distributed to the various tissues. It seems reasonable, however, to assume that all classes of medicines possess characteristic properties when introduced either in **large or small doses** into the economy.

While all medicines are not foreign to the human system, scarcely any of the preparations of the materia medica can be used in any considerable dose, in health or disease, without producing an effect; this effect may be **immediate,** or it may be **deferred**; it may be manifested by certain symptoms in **health,** and in **disease** these symptoms may be materially modified. This, of course, will depend upon various **factors,** such as the physical condition of the patient, the amount of the dose prescribed, the frequency of its repetition, and the length of time it may be continued. In these calculations it will be noted that no reference has been made to **hygienic factors,** as food, air, sunlight and exercise, and without these latter considerations much of our pharmacological data is of little value, hence the necessity of their receiving attention in the treatment of disease.

Alteratives are generally regarded as remedies that **increase metabolism**; that is, their presence in the system favors tissue-change, and an attempt has been made to estimate the value of certain remedies by calculating the amount of urea discharged, but this method has been found fallacious. **Water,** when taken in considerable quantities, is an efficient agent in producing **tissue-change** and augmenting the excretion of urea, but ordinary water is not admitted to possess medicinal properties. On the other hand, **alcohol** is a remedy which is believed to possess strict medicinal properties, but alcohol does not always act as an agent favoring increased metabolism, if we accept the view that increased tissue-change and increased excretion of urea mean increased metabolism. **Small doses** of alcohol lessen destructive metamorphosis, but large doses produce the opposite effect, as shown in the destructive changes which are found in the mucous membrane of the stomach and in the liver after the continued use of this remedy. This demonstration, however, is not dependent upon post-mortem changes that have been discovered

in man, but the same, or similar changes, have been found to take place in animals where the drug had been administered for a considerable length of time hypodermatically. It has been suggested that alteratives so increase tissue-change that those **cells** which may be regarded as **disease-products** are advanced in growth to such an extent that their life processes become extinct through increased vitality. Thus, we use **arsenic** in the treatment of chronic pulmonary affections, because arsenic appears to favor the destruction of morbid products, causing their absorption. The view that arsenic causes **fatty degeneration** is very generally accepted, and, when long continued, this action will be apparent from the condition of the liver, as well as that of other organs. The true position, therefore, of arsenic seems to be yet unsettled, as it produces fatty degeneration in health as well as in disease, but we must bear in mind the somewhat paradoxical statement regarding the health-giving properties of arsenic in the Styrian arsenacophægi, and that brings us back to the hygienic factors involved in the treatment of disease. The Styrians are robust, salacious, and pugnacious, and lead an outdoor life, while many of our patients are handicapped by an hereditary or other weakness due to extraneous influences and habits of life, and, as a matter of fact, we discover that arsenic has a decided effect when long continued in temperate climates.

Other remedies belonging to the class of alteratives do not produce a like effect upon the system as arsenical alteratives, although the two groups comprising preparations of **antimony and phosphorus** resemble arsenic in their action upon tissue-change. These three drugs, and preparations made therefrom, have long been noted for their power to modify the vital functions. **Their use** extends to cutaneous, respiratory, nervous, and nearly all classes of glandular affections, but all of them are liable to produce **fatty degeneration** of the liver and other organs.

Mercurial alteratives are of great value in the treatment of syphilitic affections, and have been used extensively, either alone or in combination with **iodine alteratives** for the removal of the products of inflammation. **Chlorine alteratives** are valuable for their antiseptic properties, and especially for the property they seem to possess of increasing oxidation, chlorate of potash being the representative of the group. The reputation of **sulphur** as an alterative has rather increased than diminished, and there is a popular belief in the efficiency of sulphur for a long list of diseases, but to Ringer we are indebted for the introduction of **calcium sulphide,** one of the most valuable alteratives we possess in all classes of inflammatory action aside from specific cases. The clinical value and extended uses of this drug have yet to be learned by a large majority of the medical profession.

The following list of some of the better-known alteratives will be of some advantage to those who are beginning the study, as well as others who wish to form a better acquaintance with this important class of preparations. No attempt has been made to account for the alterative characters of the **vegetable drugs** included in this selection, as that matter will receive attention in its proper place :—

Alteratives.

MERCURIAL ALTERATIVES.

Green iodide of mercury.
Mercury in a highly divided state, as in blue pill and in gray powder.
Bichloride of mercury (corrosive sublimate).
Red iodide of mercury.
Subchloride of mercury (calomel).

IODINE ALTERATIVES.

Iodine.
Iodoform.
Iodol.
Iodide of iron.
Iodide of lead.
Iodide of potassium.
Iodide of sulphur.

CHLORINE ALTERATIVES.

Chlorate of potash.
Chlorinated lime.
Chlorinated soda.
Chloride of ammonium.
Chloride of calcium.
Chloride of sodium.
Chlorine water.
Nitro-hydrochloric acid.

ARSENICAL ALTERATIVES.

Arseniate of soda.
Arsenious acid.
Arsenite of potash (in liquor arsenicalis).
Hydrochloric solution of arsenic.

ANTIMONIAL ALTERATIVES.

Oxide of antimony.
Sulphurated antimony.
Tartarated antimony.

SULPHUR ALTERATIVES.

Sulphide of ammonium.
Sulphide of calcium.
Sulphur (sublimed or precipitated).

PHOSPHORUS ALTERATIVES.

Hyposulphite of lime.
Hyposulphite of soda.
Phosphorus (in pill or oil).

ALTERATIVES OF UNDETERMINED ACTION.

Colchicum.
Dulcamara.
Elm-bark.
Gold.
Guaiac.
Ichthyol.
Indian sarsaparilla (Hemidesmus).
Lappa.
Mezereum.
Phytolacca.
Rumex.
Sanguinaria.
Sarsaparilla.
Solanine.
Stillingia.
Taraxacum.
Xanthoxylum.
Cod-liver oil.

EXHILARANTS.—The value of the classification decided upon will be apparent from a study of the first of a group of remedies affecting the economy through the **nervous system.** Although the effects of exhilarants are appreciated, the fact that these effects are produced through the influence of the nervous apparatus acting upon the **vascular system** is not probably so well understood as it should be. Exhilarants comprise a class of remedies which act upon **the brain** and increase its activity, and includes both cerebral and vascular stimulants. As a rule, the effect of these remedies is **transient** and soon disappears, but when continued, as in the case of alcohol, intoxication follows, and the remedy thus becomes an inebriant. If the alcohol be long continued the **narcotic** effects will be developed, and we are thus enabled to follow the influence of exhilarants in their action upon the body through the nervous system in small doses, in large doses, and in large doses long continued.

The **primary effect** of exhilarants is an exaltation of the mental as well as the physical functions, and is due to an increased supply of arterial blood to the vital centres. We can understand the phenomena of **cerebral stimulation** by observing the stage of excitement in producing anæsthesia, or after taking small quantities of alcohol, at which times the brain receives a larger supply of blood than usual and causes talkativeness; after the anæsthetic effect develops this rambling talk ceases. A familiar example of a temporary stimulant, attended by vascular dilatation may be seen at the dinner-table, or another illustration is to be found in the disposition of some persons to be more talkative when lying down than when standing up. In those persons suffering from lack of vascular tonicity, there will be a tendency to **drowsiness** during the day, but when night comes on they are never at a loss for words to express their ideas after retiring. So it is often that in literary persons composition will proceed much more rapidly when in the recumbent position, and we all understand how natural it is, when engaged in deep thought or study, to allow the head to droop.

The stimulating effect of **tea** and **coffee** is well known, as well as the **chewing** of various substances and **smoking** and **sipping** of alcohol, but of course all these influences are but transitory. The value of **nitroglycerin,** a remedy which dilates the arterial capillaries, is now recognized, and it has been practically demonstrated that persons apparently moribund from the effects of narcotics or from hæmorrhage may be revived by its hypodermatic use. **Strychnine** is an invaluable remedy for the relief of insomnia due to the lack of vascular tone, and should be used in all those cases where we suspect dilatation of the abdominal blood-vessels.

The following list will serve as a guide to the further investigation of the subject :—

Exhilarants.

Alcohol in the form of distilled spirit, as
- Brandy,
- Malt liquors,
- Wine.

Acetate of ammonium.
Acetic ether.
Camphor.
Chloroform.
Ether.
Heat.
Indian hemp.
Nitroglycerin (?).
Opium (in small doses).
Strychnine (in small doses).
Tea and Coffee.

HYPNOTICS and **NARCOTICS** are remedies which act upon the nervous system, either through the nerve-centres or upon the peripheral extremities. The attempt to define them, and indicate definitely those remedies which may be classed as anodynes, and those which are entitled to be regarded as hypnotics and narcotics, is a problem difficult of solution. Those drugs which in medicinal doses act as **simple hypnotics** when exhibited in sufficient quantity will be followed by the characteristic **narcotic** effect, and remedies which are only hypnotics indirectly, when given in sufficient doses, will be followed by narcotism. Thus, **digitalis** may be a useful remedy in overcoming **insomnia** due to vascular derangement by reason of its power to lessen the supply of blood to the brain, but, given in sufficient doses in **delirium tremens,** not only the sedative effect of the drug will be manifested upon the nervous system but the narcotic effect as well. **Morphine** and **atropine** are well-known physiological antagonists, but given in **combination** we are able to produce narcotic effects from comparatively small doses.

Anodynes are remedies more particularly intended for the relief of pain, and when used locally they are called **analgesics. Belladonna** is an example of the latter; when applied to boils and carbuncles the pain is relieved, probably through its action upon the peripheral sensory nerves; atropine, its active principle, applied to an inflamed conjunctiva with ocular tension, relieves pain by acting upon the nerves and causing dilatation of the pupil. **Aconite,** applied locally, relieves pain by favoring increased circulation, while at the same time the peripheral extremities of the nerves are paralyzed. Both aconite and **gelsemium** are efficient remedies for the relief of supraorbital neuralgia, and **Indian hemp** will frequently be found efficient where these remedies have failed. The latter remedy is especially valuable as an anodyne in the treatment of dysmenorrhœa.

The **phenomena of sleep** are useful in directing our attention to the proper application of hypnotics and narcotics. Brunton has defined **hypnotics** as substances which, in the doses necessary to produce sleep, do not disturb the normal relationship of the mental faculties to the external world, while **narcotics** do disturb this relationship, the latter being

in some respects similar to **stimulants.** In **normal sleep** there is a marked diminution of functional activity, which reaches its maximum during the early morning hours; arterial tension is lessened, the superficial vessels dilated, the pulse and respiration slowed, and there is pronounced anæmia of the brain; reflexes are not wholly subdued, but there is a lack of muscular co-ordination; a similar want of mental co-ordination is manifested by the occurrence of irregular fancies called dreams.

The object of **hypnotics,** therefore, should be to diminish the cerebral circulation by modifying **vascular activity.** Those remedies which simply reduce the activity of the heart will be useful in insomnia, providing the patient is placed in a position most favorable for relieving congestion of the cerebral tissues. **Posture** is an important element in the treatment of all affections requiring the use of hypnotics, as without instruction upon this point the medicament may be continued until narcotism is produced, when collapse may be threatened and active measures for restoration must be adopted.

The condition just described is that called **coma**; the **veins** are dilated, the cerebral tissues suffer from passive congestion, due to the lack of proper aëration. Such condition is materially different from that of **arterial congestion**, which is of comparatively rare occurrence. The use of the **bromides** in connection with posture often forms a valuable clinical aid to the physician. In addition to their **sedative action** upon the nerve-centres, they also possess considerable power in controlling the arterial blood-supply through their influence upon the **vasomotor** system In this latter respect **chloral** seems to be less efficient, while its administration is often contra-indicated by the condition of the heart. **Opium** and its derivatives are probably our most useful hypnotics, and as their effect upon the system is better understood they may be more safely used, and the bromides follow next in order.

A new class of, hypnotics, including urethan and hypnone, have lately been introduced and are included in the following list, but it may be suggested that, as a rule, the physician will be most successful in the use of these remedies who becomes thoroughly familiar with their special properties.

As **adjuvants to hypnotics** may be mentioned such local measures as warmth to the abdomen in the shape of poultices, fomentations, compresses, or the use of the hot-water bag; cold to the surface, as the wet pack, may also be used to allay cardiac excitement, or, instead, the surface may be sponged, or cold water may be taken internally. When there are indications of uterine complications which disturb repose, cimicifuga will often prove an acceptable substitute for the usual remedies.

Hypnotics and Narcotics.

Aconite.	Hypnone.
Alcohol.	Lettuce.
Belladonna, Atropine.	Lithium bromide.
Calcium bromide.	Monobromo-camphor.
Cannabin tannate.	Morphine and its salts.
Cannabis indica.	Nickel bromide.
Chloral hydrate (Uralium).	Opium, Narceine.
Chloroform.	Paraldehyde.
Conium.	Potassium bromide.
Croton chloral.	Sodium bromide.
Digitalis.	Stramonium.
Ether.	Sulphonal.
Gelsemium.	Urethan.
Humulus.	Zinc bromide.
Hyoscyamus.	

ANODYNES OR ANALGESICS.—Anodynes are remedies which relieve pain by lessening the sensibility of the nerve-centres or the peripheral extremities. When applied locally they are called **analgesics,** and may therefore be classed as general and local.

GENERAL.

Aconite.	Conium.	Hyoscyamus.
Belladonna, Atropine.	Croton chloral.	Lupulus.
Cannabis.	Ether.	Morphine.
Chloral hydrate.	Gelsemium.	Opium.
Chloroform.	Heat and Cold.	Stramonium.

LOCAL.

Acupuncture.	Cocaine.	Heat and Cold.
Antipyrin.	Conium.	Hydrastis.
Belladonna.	Creasote.	Iodoform, Iodol.
Blood-letting.	Eugenol.	Laudanum.
Carbolic acid.	Hamamelis.	Stramonium.

ANÆSTHETICS are substances introduced into the system by inhalation, and possess the property of annulling **consciousness** and obtunding the sense of **pain**; they may be regarded as hypnotics, but the effect upon the nervous system is more immediate and less persistent than that of hypnotics. Anæsthetics are used to overcome pain and suffering from surgical operations, to quiet spasm and other cerebral disturbances, and to cause relaxation of the muscular system in case of dislocation and hernia. These remedies affect the **cerebral and spinal centres**; they not only abolish pain, but they destroy sensation and reflex excitability, and in this respect they differ from anodynes, which do not destroy the centres of reflex action. The difference between anæsthetics and anodynes, however, is principally one in degree rather than of kind.

The action of anæsthetics is either **direct or indirect**; an illustration

of the former is seen in the use of both chloroform and ether, which act upon the nerve-cells, whether applied locally to the brain-tissue, or through the blood. These remedies act as **protoplasmic poisons,** and it is upon this theory that chloroform is supposed to cause arrest or stopping of the heart-action.

Anæsthesia may be produced **indirectly,** by stopping the circulation of the blood in the brain, by directing it into other channels, by rapid breathing, by diminishing the internal respiration, as in the inhalation of noxious gases.

With the exception of **nitrous oxide,** all anæsthetics belong to the class of alcohols and ethers; and alcohol alone, when volatilized and inhaled, will also produce anæsthesia.

Chloroform and ether narcosis differ in respect to their influence upon the reflexes, patellar, cutaneous and conjunctival; in the former they are diminished, while in the latter they are increased. Chloroform affects the vasomotor centre, thus destroying the control of blood-pressure, and to this cause may be traced the accidents attending minor surgical operations in the dentist's chair. A small quantity of chloroform is administered, but not sufficient to produce complete anæsthesia, when the **shock** of the operation causes paralysis of the cardiac ganglia.

Anæsthetics are either **general or local**; of the former, a list including the more important, has been prepared; the latter have already been considered on the preceding page, under the head of analgesics.

Anæsthesia may conveniently be divided into **four stages,** as follows:—

(1) Stage of excitement.
(2) Stage of narcosis.
(3) Stage of anæsthesia, and
(4) Stage of paralysis.

The fourth stage is to be avoided, and precautions should be adopted to prevent **untoward results** from the use of anæsthetics. For this purpose, one of the **best means** consists in the use of morphine and atropine hypodermatically, given just previous to the administration. They not only prevent shock and paralysis of the heart, but they also become available for their narcotic properties, and diminish the amount of anæsthetic required.

The **dangers** from anæsthesia have already been indicated, but it may be remarked that while chloroform is supposed to affect principally the heart, ether is more liable to cause embarrassment of the respiration. The vapor of chloroform should be administered with a considerable admixture of atmospheric air, but ether may be given in more concentrated form, and in case of danger threatening, **artificial respiration**

should be instituted, or the patient may be allowed to inhale the vapor of amyl nitrite, or trinitrin may be used hypodermatically.

The dangers of **suffocation** should be avoided by preventing blood or vomited matter from gaining access to the trachea, and when patients are required to undergo operations in the erect posture it should be exchanged as soon as possible after the completion of the operation.

Anæsthetics.

Bichloride of ethidene.	Ether.
Bichloride of methylene.	Iodide of ethyl.
Bromide of ethyl.	Protoxide of nitrogen (nitrous oxide).
Bromoform.	Tetrachloride of carbon.
Chloroform.	Trichlorhydrin.

SPINAL STIMULANTS are remedies which increase the functional activity of the spinal cord, of which **strychnine** may be accepted as the representative of the group. **Opium** in small doses produces sedation, but larger doses will cause convulsions, an illustration going to show that the effects of a drug depend upon the amount of the dose administered, rather than from a change in its method of action,—a subject more fully considered under the head of nux vomica (q. v.).

Spinal stimulants are of value in the treatment of various affections, although the lack of exact pathological data often places the physician at a disadvantage.

The **indications** for the use of this class of remedies may be briefly summarized, as follows: General debility, paralysis in the absence of inflammation, such as paraplegia, hemiplegia, and in local paralyses. A somewhat peculiar physiological effect should be noted in connection with the use of strychnine in paralysis, viz., that when the drug is pushed until muscular twitchings appear, the paralyzed muscles are the first to be affected, and show more distinctly the effects of the drug.

Spinal Stimulants.

Absinthe.	Camphor.	Nux vomica.
Ammonia.	Cannabis indica.	Opium.
Arnica.	Cantharides.	Phosphorus.
Belladonna.	Cimicifuga.	Rhus toxicodendron.
Brucine.	Ergot.	Strophanthus.
Buxine.	Ignatia.	Strychnine.
Caffeine.	Morphine.	Thebaine.
Calabarine.	Nicotine.	Ustilago.

SPINAL SEDATIVES, as contradistinguished from spinal stimulants, are remedies which lessen the functional activity of the cord. The **bromides** are especially serviceable in this class of cases, and **conium** has long been recognized for its therapeutical value in this direction.

Gelsemium is of more recent origin, and is frequently of decided service in overcoming irritability of the nervous system accompanied by great motor excitement.

Where inflammatory changes are going on in the cord, or where there is reason to believe that we have to deal with irritable conditions, as shown by spasmodic affections or cough, or where there may be undue prominence of the sexual functions, spinal sedatives will be found efficient remedies. This group might be increased indefinitely by the addition of the major portions of those remedies variously referred to as anæsthetics, hypnotics and narcotics, anodynes and analgesics, and antiperiodics, but the direct relations between these different classes are so readily appreciated that their reproduction does not seem to be demanded.

Spinal Sedatives.

Bromide of ammonium.	Conium.
Bromide of lithium.	Calabar bean.
Bromide of nickel.	Gelsemium.
Bromide of potassium.	Hydrocyanic acid.

ANTISPASMODICS are closely related in their action to spinal sedatives, and the latter may often be used as temporary adjuvants, the **real adjuvants,** however, being general hygienic measures and increased nutrition. The medicinal agents known as antispasmodics are substances which are supposed to act upon some portion of the nervous system and upon the ganglionic system.

Chorea furnishes an indication of the demand for antispasmodics; contraction of the muscular walls of the intestine will cause colic; any interference with the circulation of the blood in the extremities will cause spasmodic contraction of the muscles, which finds a familiar illustration in cramp in the calf of the leg. **These examples** of deranged nerve-supply are to be met by the exhibition of certain remedial agents, determined according to existing conditions. The cause must be removed by the adoption of suitable hygienic surroundings, and nutritious aliment should be selected.

The theory that spasmodic attacks were due to increased vitality has given place to more conservative views, and physicians now recognize that the use of medicine is but palliative. Of the accompanying list of antispasmodics a few words may be added by way of explanation. **Direct antispasmodics** include different classes of remedies, which in the main may be regarded as spinal tonics; one group contains sulphur oils, of which asafœtida is the representative; another group comprises a class of stimulants which possess peculiar odors, derived from plants and animals. Valerian and sumbul include the former, while musk and

castor belong to the latter. These special antispasmodics, which are used largely in hysterical affections, depend to some extent upon the presence of this odor, and are believed by some to have an influence through the action of the odor upon the higher cerebral centres. To some extent the different oils, as well as camphor and ammonia, may partake of this property. The **indirect antispasmodics** are principally those remedies which act as sedatives to the spinal cord, like conium and the bromides, but there are others which are to all intents and purposes nerve-tonics, such as the salt of zinc, silver, and copper, while hydrocyanic acid is a remedy which has a marked effect upon the entire system. The value of belladonna, stramonium, and other vegetable remedies will be inferred from the narcotic properties they are known to possess, while **amyl nitrite and trinitrin** are more especially valuable in spasm of the blood-vessels.

This latter observation should not be neglected in the treatment of spasmodic affections of the pulmonary apparatus, such as we see in the attacks of **spasmodic asthma** at certain seasons of the year. Nor should the value of oxygen inhalations in these instances be overlooked, subjects which will receive attention under the appropriate headings.

Antispasmodics.

DIRECT ANTISPASMODICS (SPINAL TONICS.)

Asafœtida, Galbanum? Ammoniacum? — Containing sulphur oils.	Oil of rue.
	Oil of turpentine.
	Oil of cajuput.
Valerian, Sumbul, — Derived from plants.	Camphor.
	Ammonia (free).
Musk, Castor, — Derived from animals.	Carbonate of ammonia.

INDIRECT ANTISPASMODICS.

Spinal sedatives, as	Stramonium.
Conium.	Henbane.
Bromide of lithium.	Indian hemp.
Bromide of potassium.	Opium.
Bromide of ammonium.	Chloroform.
Bromide of nickel.	Ether.
Nervine tonics, as	Acetic ether.
Salts of zinc.	Arsenic.
Salts of silver.	Lobelia.
Salts of copper.	Nitrites:—
Hydrocyanic acid.	Nitroglycerin (Trinitrin),
Belladonna.	Amyl nitrite.

ANTIPERIODICS AND NERVINE TONICS.—In the treatment of certain classes of affections, of which intermittent fever and neuralgia may be accepted as illustrations, a number of remedies possessing in the main similar properties have been used to overcome them. These remedies are called by common consent antiperiodics; and along with them

Garrod has pointed out the value of other remedies, acting upon the nervous system, which he has very appropriately named **nervine tonics.** These latter differ from the former in not possessing antiperiodic properties, but they are of decided value in overcoming the depression accompanying intermittent fevers and like affections, and when judiciously employed will materially **hasten recovery.** It should be mentioned that antiperiodics are closely **related to alteratives,** through arsenic, which is one of the most valuable and generally useful of the remedies of both groups.

Certain **adjuncts to antiperiodics** are almost of equal importance with the remedies themselves, and it has been suggested that mercurials, like the protiodide, accompanied by suitable hygienic rules, would be sufficient to eradicate attacks of ague. In years gone by a high value was placed on the use of **emetics** and **purgatives** in connection with the administration of antiperiodics, but we can now see that these depressing methods produced an effect by relieving undue tension, by favoring increased activity of the liver, and by removing excrementitious products through increased functional activity of the skin, increased urinary flow, and profuse discharges from the bowels. It is plain, therefore, that our methods of treatment should conform to the principles just outlined, but the practice must be modified to accord with the advances in pathology and in pharmacology.

The first point to be considered in the treatment of malarial affections is the **condition of the liver,** and if one remedy is insufficient to secure the desired results, another should be selected which gives more promise of success. For many years it was assumed that **podophyllum** was as necessary to the successful treatment of ague as quinine, but the facts are that podophyllum affects this organ when in a diseased condition favorably in almost all cases, hence the erroneous conclusion that quinine was more efficient when combined with podophyllum. **Ipecac** will often be of greater benefit than podophyllum, because it can be used in substance in a much larger number of cases than can the latter, but the fact should not be overlooked that a purgative may be required in connection with ipecac.

Quinine itself, or its salts, or, in fact any of the alkaloids of cinchona, when given in sufficient quantity, will be found to act as decided purgatives through their influence upon the liver; if continued, it will be found that within a few days the purgative effect of the medicine will disappear, and although the patient may feel the depressing effects of active purgation, he will gain strength, appetite will increase, and within a week all symptoms of malaria will have vanished. The foregoing is an illustration of mild cases, which frequently come under the observa-

tion of the practitioner; those which have been longer in progress, where the patient has been under self-medication, other and more active measures will have to be adopted.

Antiperiodics.

Arsenic and its preparations.	Eucalyptus globulus.
Berberine sulphate.	Picrate of ammonia.
Cinchona barks and their alkaloids.	Picric acid.
Cinchonidine and its salts.	Quinidine and its salts.
Cinchonine and its salts.	Quinine and its salts.

Nervine Tonics.

Brucine.	Oxide of zinc.
Cusparia.	Salts of iron.
Nitrate of silver.	Strychnine.
Nux vomica.	Sulphate of copper.
Oxide of silver.	Sulphate of zinc.

Action Uncertain.

Calumba (?).	Salicin (?).
Chamomile (?).	Salicylates.
Podophyllum.	Salicylic acid.
Quassia (?).	

VASCULAR STIMULANTS.—Vascular stimulants may conveniently be divided into **two classes,**—those which act upon the heart and large vessels, and those which act upon the smaller vessels. The former have already been considered under the head of exhilarants, and a few words will be sufficient to indicate the application of the latter. Vascular stimulants which act upon the smaller vessels are of especiál value where it is desired to increase the activity of the local circulation, and their use can often be supplemented to advantage by the addition of suitable local measures.

Therapy.—These remedies are useful in the treatment of diseased conditions characterized by depression, and are especially valuable in heart diseases, either acute or chronic, when their exhibition is not contra-indicated by the presence of valvular diseases or fatty degeneration. In the latter case, cardiac tonics should be combined with stimulants with a view to overcome the physical condition.

In concluding this section it may be remarked that many of these remedies possess peculiar properties which are of great value to the physician, owing to their influence upon the functions of various special organs, while others produce an effect which is more general in its nature. Chloroform, carbonate of ammonia, oil of turpentine, and guaiac furnish examples of the former, while camphor, asafœtida and valerian serve as illustrations of the latter class.

Vascular Stimulants.

ACTING MORE ON THE HEART AND LARGER VESSELS.

Alcohol in the form of brandy.
Aromatics :—
  Aromatic spirit of ammonia,
  Aromatic volatile oils.
Asafœtida.
Camphor.
Carbonate of ammonia.
Chloroform.
Ether.
Free ammonia as in the solution of ammonia.
Oil of turpentine.
Spirit of ether.
Sumbul.
Valerian.
Wine.

ACTING MORE ON THE SMALLER VESSELS.

Ammoniacum.
Acetate of ammonia.
Citrate of ammonia.
Galbanum.
Guaiacum.
Mezereum.
Resin.
Sassafras.
Serpentary.

VASCULAR SEDATIVES.—Vascular sedatives are also conveniently divided into **two general classes,**—those which affect especially the heart, and those which act upon the smaller vessels and capillaries. They might also with propriety be **further divided** into those which affect the smaller vessels by contracting them, and those which affect the same class of vessels by increasing their calibre. When speaking of laboratory investigations, experimental physiologists have often left us in the dark concerning what they mean by the word "**blood-vessels,**" when used by them to denote the effect of remedies upon the tissues. We know from clinical experience that **digitalis** lessens the flow of blood by diminishing the calibre of the arterioles, but it does not cause blanching of the face, such as may be seen after the exhibition of **ergot.** The effect of digitalis is therefore different from that of ergot; the action of ergot upon the arteries is similar to that of digitalis, but after leaving the arterial system the ergot seems to act further upon the tissues by contracting them,—a property which digitalis does not possess. It appears, therefore, that digitalis and ergot are vascular sedatives by reason of their power over the arterioles by which the lumen of the vessels is diminished, and the slowing of the heart follows upon this increased resistance.

On the other hand, **amyl nitrite,** and the nitrites generally, are vascular sedatives by reason of their power to lessen the resistance of the heart's action, by increasing the calibre of the arterioles. The exhibition of these latter remedies is followed by flushing of the face, a condition the very opposite of that found after the exhibition of ergot. It appears reasonable to assume that the nitrites may be used as vascular sedatives as a means of effecting a redistribution of the circulating fluid, just as a person very much excited from undue exertion assumes the recumbent position, with a view to overcome a sense of nervousness and discomfort.

Preparations of **antimony**, as also tobacco and conium, seem to act as sedatives in a revulsive manner, and depress the whole system. **Aconite** and **gelsemium** appear to have special indications of their own, the former acting at first upon the smaller vessels, when given in small doses, and later upon the heart, while the latter possesses the property of affecting the heart from the beginning. **Colchicum** is valuable in gouty inflammation. **Ipecacuanha** is often useful in lowering the circulation, while at the same time it relieves tension, but it is far less energetic than antimony.

The foregoing remarks have been made from the stand-point of the clinician rather than from the strictly scientific point of view, but, from the fact that the subjects are fully considered in their scientific bearings under their respective headings, it was deemed advisable in this place to present the matter as viewed from bedside experience.

Vascular Sedatives.

ACTING ESPECIALLY ON THE HEART.

Aconite.	Ergot.	Strophanthus.
Calabar bean.	Gelsemium.	Tobacco.
Colchicum.	Green hellebore.	Veratrine.
Digitalis.	Hydrocyanic acid.	Cold.

ACTING ON THE SMALLER VESSELS AND CAPILLARY SYSTEM.

Acetate of lead.	Ipecacuanha.	Opium.
Amyl nitrite.	Nitrate of potash.	Oxide of antimony.
Ergot.	Nitrites.	Tartarated antimony.
Hamamelis.	Nitroglycerin.	

VASCULAR TONICS.—Vascular tonics, as their name indicates, include all those remedies which either directly or indirectly give **tone** to the **vascular system.** Whatever improves the nutrition is opposed to disease, and all those remedies which increase nutrition improve the vascular tone and increase the power of the heart. The representative of this class of preparations is **iron** in its various forms, but iron is less prompt in its action than preparations of **nux vomica,** but more especially the salts of strychnine. The value of these remedies depends largely upon their power to maintain **blood-pressure** and modify **tissue-change,** and, as a matter of course, they become of special importance in the treatment of low conditions of the system, brought about by acute disease or by long-continued illness. Their value is most noticeable in the treatment of **dropsy,** in which not only the lymph-spaces, but also the large serous cavities are surcharged with serous accumulations. Œdema, ascites, pleural and pericardial effusions are dependent upon functional inactivity of the tissues, to a limited extent by the condition of the blood, and partly owing to derangements of the vasomotor system. It has been

suggested that some alteration of the blood-vessels renders them more permeable, with the result of **imperfect oxidation** and the formation of sarco-lactic instead of carbonic acid, and that the tendency of arsenic to produce œdema of the eyelids may be due to its action in lessening oxidation.

For **immediate effect,** in cases of emergency, with derangement of the vasomotor system, as shown by a tendency to coma, it is doubtful if we have any remedy more potent than **oxygen inhalations.**

From an examination of the following list it will be seen that, in addition to iron preparations, nux vomica and its preparations, we have also included those drugs properly coming under sub-heads which have already been considered, which goes to show the value of nutrition in securing and maintaining a healthy tone in the blood-vascular system.

Acids and Astringents.	Caffeine.	Nux vomica and its preparations.
Adonidin.	Convallaria.	Oxygen inhalations.
Alcohol.	Digitalis.	Sparteine.
Ammonia.	Ergot.	Stomachic tonics.
Blood tonics.	Iron preparations.	Strophanthus.
Cactus grandiflora.	Nervine tonics.	

General Observations.—We have elsewhere referred to the importance of vascular tension. The treatment of disease is not infrequently hedged about with difficulties, and at times they are apparently insuperable; hence, a consideration of one of the most important conditions met with, and one, too, which has been unfortunately relegated to a secondary place, deserves respectful attention. The **importance** of maintaining **vascular tension** in disease is a matter which can scarcely be overestimated, and although it is not often referred to in the course of consultations, nor in papers which are presented to societies, it is a constantly-recurring factor of variable character, and therefore requires the more careful attention on the part of the prescriber. True, many of the remedies used in the treatment of the sick are possessed of their greatest utility by reason of their action in this particular direction, but they are used, not for this reason, but for their general therapeutic effect. Thus, in ordinary affections characterized by debility, there is a general consensus of opinion as to the demand of the economy for **strychnine** in some of its forms, and it is a well-known fact that, next to **digitalis,** strychnine is one of the first remedies which can be depended upon for this purpose, while it is free from the objections attached to the former drug. In the treatment of paralysis, the use of strychnine is the first remedy to be selected because of its known action in enabling the system to correct any fault in the compensation, for by this process we secure a more perfect supply of blood to the affected part. And while the supply

of blood is regulated as well as augmented, the action of this drug is manifested in another way, the strychnine playing also the part of a nerve tonic. It should be noted here, however, that this method may work to our disadvantage, and will certainly do so if our nerve tonic is pushed to near its physiological limit. A hint here will be all that is needed to illustrate the idea we wish to convey. In a case stated, as the lawyers say, we have clearly paralysis to deal with, and it becomes a question as to what is the most appropriate remedy. Suppose, for instance, that, instead of using strychnine, we select **gelsemium**, because we know that gelsemium is a paralyzing agent, and if continued long enough in moderate doses we shall find that in time the whole system will be affected, although in the meantime the muscles originally paralyzed will show a tendency to improve. Here we have apparently one of the unsolved problems in medicine, and one, too, which has proved a stumbling-block for several generations, but it can be explained to the satisfaction of the practical physician on the basis of vascular tension,—a platform sufficiently extensive to accommodate all scientific physicians. It rests upon the bed-rock of truth, and is governed by the immutable laws which teach us the principles of physiology and pathology. The **two methods** of treatment here outlined will suggest themselves according to the demands of the case, the reasons therefor appearing later on as we proceed with the study.

Pneumonia is a disease in which the value of vascular tension is fully seen, and, aside from the microphytic influences which of late have been supposed to act as a factor in its causation, there is no denying the fact that remedies exhibited with a view to maintain a healthful condition of the circulation have a material effect upon the malady, and more especially is this the case when the disease is early recognized, as it may then be modified, if not brought fully under control. Here we have dilatation of the capillaries, with active or passive congestion, or both, and along with the local affection we have an elevated temperature. Now, **digitalis** will act as a constrictor of the terminal arteries, and it will also lower the temperature; by the use of this remedy we lessen the frequency of the heart-beats, and the secretion from the kidneys is sensibly augmented, but yet it is not a drug which has attained any prominence in the treatment of this disease, simply because it will defeat the purpose for which it was originally given if long enough continued. We have recourse, therefore, to **other remedies** which will serve our purpose better. We want a remedy which will act in some respects like digitalis, that will cause contraction of the capillaries, that will lower the temperature and increase the urinary secretion, and one that will lessen the frequency of the cardiac action, not by increasing its force, but rather by decreasing it, and

we naturally look to **aconite** for this purpose. With the advantage gained from aconite, we may, if the case is severe or threatening, add the influence of **gelsemium**, using for this purpose the fluid extract, either alone or in combination with aconite. When the patient is sufficiently under the influence of this treatment, and it is desirable to await the results of medication, it would seem probable that here again digitalis would step in to assist in maintaining for the time the compensation, but we venture to recommend that much-abased drug—quinine—in its stead. **Quinine** not only maintains the vascular tension, but it materially interferes with the spread of the disease by continuity to adjoining tissues, and in this manner it becomes a **germicide** of no mean proportions. If pneumonia is of parasitic origin, few remedies can have a more decided influence upon its progress than quinine, but it should be given at the proper time and in suitable doses. When the **arterial tension** has been sufficiently **relaxed** by the treatment recommended, quinine will be useful, but in the stage of active congestion it is, in our opinion, worse than useless, it is positively harmful. The dose should always be a substantial one, but adapted to the physical condition of the patient and the period of the disease; five, ten, or even fifteen grains at one time, or within, say, two hours, and this need not be repeated for the space of twenty-four hours, the vascular tension in the interval being kept at as low a level as is consistent with safety.

Typhoid fever will be managed best in this respect by the judicious administration of strychnine in fractional doses; and when there are signs of cardiac depression, in addition to the use of diffusible stimulants, **strophanthus** is demanded. The treatment in **remittents** and **intermittents** will be favorably modified by observing the points given in regard to the administration of quinine in pneumonia, but it is not at all times practical to have the vascular tension so modified in these affections, and we are, therefore, compelled to depend largely on the use of quinine itself for this effect. In consumption, catarrhal pneumonia, and chronic bronchitis another remedy suggests itself by reason of its action in lessening the arterial tension by dilating the capillaries, and this may be accomplished by the exhibition of **nitroglycerin**. No drug possesses the power to give immediate relief such as this. Murrell discovered its wonderful effects in the treatment of angina pectoris, and it may be used with advantage in all cases where there is undue tension of the capillaries or of the terminal arteries. **Aconite**, on the other hand, is more valuable where we suspect dilatation of the capillaries, but more especially those of mucous surfaces. **Gelsemium** is valuable on account of its general paralyzing action, and will be found useful in many diseases which have hitherto baffled the most skillful practitioners.

The following extract from a paper by Webber, of Boston, will be of interest:—

"He concludes that neurasthenic patients may be divided into several classes: 1. Those in whom the vascular tension is nearly or quite normal. These patients are only temporarily run down, and soon recover. 2. Those who at first show a decided loss of vascular tone, but who regain a normal tension after a course of treatment. These patients usually recover after a longer or shorter time. 3. Those whose vascular tone is very much below normal, and whose tension sometimes apparently increases, and then, again, loses ground. These cases do not improve much, and whatever is gain is of doubtful permanency, owing to a lack of vascular stability. In a few cases the early tracings showed a nearly normal condition of the blood-vessels, but later ones were less favorable; there being always some cause to which the change could be ascribed. Some of the worst cases exhibited a great variation of tension within a few minutes. The author concludes, further, that the sphygmograph is an aid in determining the amount of exhaustion; and by comparing tracings indicates the progress toward recovery. A fictitious gain may be distinguished from a real one, since none is genuine unless the tension of the arteries is permanently restored. Tracings should be taken once in two or three weeks."

SIALAGOGUES.—Sialagogues are remedies which increase the **salivary secretion,** and may be used to advantage for the relief of various classes of morbid conditions. The influence of the **nervous system** must be taken into consideration in deciding upon the indications for the use of sialagogues. It is well known that sudden emotion will stop the flow of saliva, and at the same time we recognize that mental influences may cause a profuse outpouring of the salivary secretion, and that it may be affected through the sight, or through the medium of the olfactory organs, or it may be produced without either.

Garrod divides sialagogues into **topical** and **remote,** the former including such substances as pyrethrum and horse-radish, the latter mercurial salts and the iodides; but the suggestion of Brunton that these remedies should be classed as **reflex** and **specific** sialagogues appears to be more appropriate, although tobacco and iodide of potassium act both specifically and reflexly. The presence of tobacco in the mouth causes a flow of saliva, and thus acts in a reflex manner; potassium iodide, taken into the system, is rapidly eliminated by the salivary glands, and is thus made to do service like tobacco. These two remedies, therefore, and mercury, may be properly classed as mixed sialagogues.

It is doubtful if much benefit follows the **use of acids,** alkalies, or such pungent substances as mustard and the like, when used solely for

their effect upon the salivary glands, and the value of **nauseants,** such as tartar emetic, has always seemed questionable. Our **interest** in the matter of sialagogues, however, **centres** in the use of **pilocarpus,** which not only serves in a remarkable manner to increase the salivary secretion, but also the secretions of the entire alimentary tract and that of the cutaneous system as well, and the numerous applications that have been discovered for it attest its popularity, which promises to increase with better acquaintance.

As contradistinguished from sialagogues, **antisialics** may be mentioned, remedies which lessen the flow of saliva, the principal remedies of this class being potassium chlorate, physostigmine, and atropine.

Reflex Sialagogues.

Acids, mineral and vegetable.	Pungent substances :—
Alkalies.	Ginger,
Chloroform and Ether.	Horse-radish,
Cubebs.	Mustard,
Nauseants:—	Pellitory root (Pyrethrum),
Tartar emetic, etc.	Tobacco when masticated.
	Rhubarb.

Specific Sialagogues.

Iodine preparations.	Physostigmine.
Mercurial preparations.	Pilocarpus (Jaborandi).
Muscarine.	Tobacco.

Mixed Sialagogues.

Iodide of potassium.	Mercury.	Tobacco.

EMETICS.—Emetics are remedies which cause **vomiting,** and are supposed to produce their characteristic effect through the influence they have upon the **nerve-centre** in the **medulla** regulating this spasmodic action.

There is a diversity of opinion as to the exact method by which these remedies produce results, but there is reason to believe that they differ materially from each other. Thus, **alum** and the **sulphate of zinc,** from their action upon the tissues with which they come in contact, will cause vomiting; **tartar emetic,** if introduced into the circulation, causes vomiting without entering the stomach. The **natural division,** therefore, would be those which are **local** and those which are **general** in their action.

The **indications** for emetics are numerous, but they are less popular than formerly, except in domestic use. Emetics are always indicated after the ingestion of **poisonous substances,** if too long a time has not elapsed, so that they have been absorbed from the stomach; also where there is reason to believe that the stomach contains **indigestible food,** and, in case of **bronchitis** and **croup,** where the mechanical effects of vomiting are desired; but it is believed that with the timely use of calcium sulphide the demand for emetics for the relief of this latter class of affections will

gradually disappear. Mustard-water or a solution of common salt are always readily obtained. The sulphate of zinc is less objectionable than the sulphate of copper. **Carbonate of ammonia** is especially indicated as an emetic where there is an enfeebled condition of the heart and circulation. Tartar emetic should always be given with **caution**, and **apomorphine** will be found an **excellent** remedy when it becomes necessary to administer an emetic hypodermatically.

Of all the emetic substances, however, there is probably none which is of more general value than **ipecac**, this property being due principally to the presence of an active principle called **emetine.** Ipecac is always **safe**, and, instead of being followed by injurious effects, it is doubtful if very large doses would be other than **beneficial** in the general class of cases demanding the use of emetics. A **substitute** for ipecac, it is claimed, has been found in **cocillana**, a South American remedy, introduced to the notice of the profession by Rusby.

With the advances in therapeutics, it is doubtful if the use of emetics is as general in the treatment of inflammatory **diseases** affecting the **chest** as was the custom ten or fifteen years ago, but in so-called **biliousness** and **fevers**, in the early stages, and in **ague**, with a bad condition of the stomach, coated tongue, foul breath, an active emetic will prove of signal service.

These remedies should be **avoided**, however, in persons who have reached **advanced age**, and in those with a tendency to pulmonary **hæmorrhage**, and should always be given with extreme **caution** when hernia is present and when there is prolapsus uteri.

Local Emetics.

Alum (powdered).	Infusion of vegetable bitters.	Mustard.
Ammonium carbonate.	Mercury subsulphate.	Water (lukewarm).
Copper sulphate.		Zinc sulphate.

General Emetics.

Apomorphine.	Ipecacuanha and Emetine.	Sanguinaria.
Cocillana.	Senega.	Squill.
		Tartar emetic.

ANTI-EMETICS.—Anti-emetics include all those remedies which act as **sedatives** to the **stomach** and to the general system. They may be used in case of persistent vomiting, to diminish pain from ulcer or cancer of the stomach, and to relieve the nausea of indigestion. Gastric sedatives **include** such remedies as bismuth and its salts, carbolic acid, cerium oxalate, and chloroform. Ordinarily, we should expect cocaine to be of special value in relieving nausea and vomiting, as well as an efficient pain-reliever, but its use has not been attended with very

encouraging results. The strength of a solution which is efficient causes untoward constitutional symptoms. **Opium** in small doses is a useful remedy, but no drug or combination of drugs will be found superior to **arsenite of copper** for the relief of the more common class of ailments of the stomach, characterized by irritability and vomiting. In the gastric disturbances of **drunkards,** and in that of the early stages of **delirium tremens,** a combination of cannabis indica with nux vomica, in small doses, has often shown remarkable power in controlling the disease.

PURGATIVES.—Purgatives are remedies which act upon various portions of the alimentary tract, causing increased peristalsis, and, along with it, increased discharge of excrementitious material. According to the effects produced, they are divided into different classes, as indicated below, and will be discussed in their order, although the subject will be considered briefly, and merely as a guide to the selection of remedies. The **effect** of this class of remedies is due largely to their **dynamical action,** and our remarks would properly be classed as a contribution to pharmacodynamics.

The action of purgatives, however, is not due altogether to the increased **peristalsis,** as from their irritant character secretion is increased, and, to a certain extent, absorption is promoted, although this feature will appear more fully later on. The theory of Thiry and Radziejewski, that purgative effects were due solely to increased peristalsis, is scarcely to be accepted when we consider that, practically, all purgatives act as irritants, and as such increase the intestinal secretions. Names have been given to the different classes which are sufficiently characteristic to indicate the results which may be anticipated when administered in the usual doses.

The method of **isolating loops** of **intestine,** for the purpose of studying the action of medicines, is open to serious objection, because by this means an extraneous factor has been introduced, the effect of which is to destroy substantially the value of the experiment. No further evidence is required as a demonstration of this proposition than the use of small doses of **laudanum** as a **purgative** in the case of ovarian irritation. Under these conditions, a single drop taken with a little water at bed-hour will act as a brisk purgative. It shows that we are warranted in assuming the reflex irritation to have been the cause of lessening the secretion and peristalsis, and as soon as this has been subdued or modified by an anodyne the normal condition is re-established; and, whether peristalsis is or is not increased by this means, **increased secretion** follows, just as increased secretion follows after the discontinuance of belladonna. That leads us to remark that **small doses** of **belladonna** will, in many cases, accomplish the same results as the use of laudanum. Another factor,

however, should not be overlooked in this connection, namely, that small doses of **opium** not only act as anodynes, but as essential stimulants of mucous tissues at the same time.

The subject of purgatives has long been a disputed one in respect to their action from a **physiological** stand-point, but we can only hint at the question in these pages. Matthew Hay has given the subject of saline cathartics careful investigation, and to his conclusions the student is referred.

Therapy.—For the removal from the **lower bowel** of fæcal accumulations as well as poisonous products due to the decomposition of food, laxatives or simple purgatives are always in order, but due regard should be had for the general condition of the patient, and if tamarinds and figs are deemed sufficient, castor-oil and rhubarb deserve no consideration. A costive habit forms gradually in the case of sedentary persons, and some of the most simple remedies are often the most useful.

The **value** of purgative medicines has been **demonstrated** by the successful floating of patent nostrums in this country now for more than a quarter of a century, and the physician who fails to relieve his patient's mental condition by appealing to an impacted colon has yet to learn the first principles of our noble science. That the physicians who practiced twenty-five years ago understood the means of securing the approval of patients by the use of purgative medicine we shall not attempt to deny, but improved methods have given place to elaterium as well as to "10 and 10."

To **remove liquids** from the body in the case of **dropsy,** the saline cathartics should be given in **concentrated** solution, when active purgative effects are desired; when given in dilute form the **diuretic** action is likely to be more appreciable than the **purgative** effects. **Salines** are not only valuable in dropsy, but by reducing the amount of water in the blood the **absorption** of inflammatory products is more actively carried on, and hence in **pleurisy** with **effusion,** when not contra-indicated by the condition of the patient, their judicious employment may be expected to hasten recovery. Within the past few years salines have been found efficient for the relief of **peritonitis** by reason of their power to remove accumulations and waste products, thus lowering temperature and blood-pressure and exerting a salutary influence upon the progress of this disease.

Certain **mineral springs** have attained wide celebrity owing to the properties they possess of increasing the activity of the bowels, and their successful use teaches us a lesson which should not go unheeded, namely, that the amount of the purgative ingredients in these waters is comparatively small, a fact which must be borne in mind in the adminis-

tration of this class of remedies generally. The **water** itself is often a valuable **adjunct** to the use of purgatives, and persons visiting springs for health and for pleasure are advised to drink largely of the water as soon as their system has become accustomed to its effect, and as a consequence much improvement follows the visit.

Large doses are to be **avoided,** because of the irritation set up in the alimentary canal, and the use of **glycerin enemata** will be found exceptionally advantageous in many cases where the use of purgatives is strictly contra-indicated. Purgatives are always to be avoided in **ileus,** as well as in occult cases of **obstruction** of the bowel, and it will be found safer to administer an enema of iced **carbonic acid water** instead of some drug which will only increase the difficulty in overcoming such obstruction.

Purgatives or Cathartics.

LAXATIVE PURGATIVES.

Carbonate of magnesia.	Honey.	Prunes.
Cassia.	Magnesia.	Sulphur.
Castor-oil.	Manna.	Tamarinds.
Figs.	Olive-oil.	Treacle.

SIMPLE PURGATIVES.

Aloes.	Cascara sagrada.	Rhubarb.
Buckthorn-juice.	Jalap.	Senna.

DRASTIC PURGATIVES.

Colocynth.	Gamboge.	Podophyllin resin.
Croton-oil.	Jalap.	Scammony.

HYDRAGOGUE PURGATIVES.

Cream of tartar (in large doses).	Elaterium.	Gamboge.

SALINE PURGATIVES.

Citrate of magnesia.	Sulphate of magnesia.	Tartrated soda (tartrate of soda and potash).
Cream of tartar (in moderate doses).	Sulphate of potash.	
Phosphate of soda.	Sulphate of soda.	
	Tartrate of potash.	

CHOLAGOGUE PURGATIVES.

Aloes.	Euonymin.	Podophyllum resin or podophyllin.
Blue pill.	Gray powder.	Taraxacum (in large doses) ?
Calomel.	Iridin.	
Colchicum ?		

ANTHELMINTICS.—Anthelmintics include a class of remedies used to **remove** or **kill** intestinal worms. They are conveniently divided into two classes: **direct** anthelmintics are those which kill the parasite, or **vermicides**; **indirect** anthelmintics are remedies which dislodge the worm,

called **vermifuges,** and the method of treatment will vary according to the object desired.

The presence of **thread-worms** in the rectum demands the local use of astringent applications in the form of **enema,** common salt, or an infusion of quassia being generally sufficient, but it will be necessary to repeat the operation several times at intervals of a few days, as the presence of mucus forms a suitable nidus for their growth, so that a single application will rarely be sufficient to dislodge them.

For the removal of **round-worms** santonin is probably the most efficient remedy of any that we possess, and its value may be increased by the addition of calomel or some other simple purgative.

It should be mentioned that the successful treatment of these cases frequently depends upon the ability of the physician to re-establish a healthy condition of the alimentary tract, the presence of mucus being especially favorable to the development of these parasites. With a view to indicate suitable **prophylactic measures,** a list of remedies has been added which act as astringents and in this way prevent the formation of an excess of mucus.

The different methods adopted for the removal of **tape-worm** have each their advocates, but for the present the consensus of opinion seems to be in favor of **pomegranate,** or the preparation made from it called pelletierine, which was discovered some years ago by Tanret. **Preliminary treatment** should always be instituted for the purpose of removing objectionable material from the bowel, and with the expectation of lessening the tenacity of the parasite. **Fasting** for twenty-four or forty-eight hours should be insisted upon, and if there is a bilious condition a simple **purgative** will be of advantage. The remedy should be given in the morning on an empty stomach, and within two or three hours this may be followed by an ordinary purgative like castor-oil. The authors have witnessed most satisfactory results by careful attention to these details.

Anthelmintics.

DIRECT ANTHELMINTICS OR VERMICIDES.

Areca.	Oil of male fern (Filix mas).	Pomegranate (bark of root).
Chloroform.	Oil of turpentine.	Santonin.
Cowhage (Mucuna).	Pelletierine.	Tin in fine powder.
Kamala.		Wormseed.
Kousso.		

INDIRECT ANTHELMINTICS OR VERMIFUGES.

Calomel.	Cocoa-nut.	Jalap.
Castor-oil.	Gamboge.	Scammony.

WORM PREVENTIVES.

Nux vomica.	Sulphate of iron.	Quassia.
Perchloride of iron.	Other ferruginous salts.	

STOMACHICS.—Stomachics, as their name implies, are remedies which affect the stomach, and for convenience of study they may be divided into **three groups,** the first group including those which are classed as **tonics,** the second those which are referred to as **stimulants or carminatives,** and the third a number of drugs which are generally accepted as **sedatives.** The division which has just been outlined is not a natural one, because it frequently falls to our lot to prescribe a remedy from each section in order to meet the indications which are presented at the bedside. A patient suffering from long-continued illness needs at the same time a tonic as an aid to digestion, which may be found in a small quantity of pepsin, but in addition to this there may be a condition of the stomach which calls for a carminative, and thus we have to select one or more remedies from each group; and if a sedative in the shape of bismuth is further required, we have one from each of the three groups. It is of advantage, however, to know that these three different classes of drugs can be combined to serve our purpose, and it will be the object of the present *résumé* to point out the conditions which conduce to the proper application of these remedies.

A glance at the different lists of remedies accompanying this section will indicate that the **first two** are mainly intended to **assist digestion** by acting as stimulants, while the third group are especially indicated for the purpose of overcoming any irritability of the organ under consideration,—a subject which it is believed is often overlooked in prescribing, and which is so often dependent upon the **condition of the liver** that we have deemed the subject of sufficient importance to give the same attention in this connection. When our whole attention is given to drugs which influence the stomach, it frequently occurs that our efforts to improve the physical condition of the patient are rendered futile by the disorganization or functional inactivity of the liver.

This subject, however, will be better understood if we take a glance at the factors entering into the **complex process** known as digestion, namely, secretion, peristalsis, and absorption. **Secretion** implies a healthy activity of the mucous membrane of the stomach, by or through which, at periodical intervals, there is a flow of liquid into the organ, which is an active agent in the manipulation of the various kinds of food coming into contact with it, and after a time the food thus acted upon is so changed that **absorption** readily takes place through the regular channels. During the time the food remains in the stomach there is constant motion of the organ, the same being referred to as **peristaltic movements,** and it is supposed that these movements materially assist in converting the albuminous portion of the food into peptones, and at the same time increase the secretions. The latter proposition is warranted by the fact that **solid**

materials taken into the stomach cause greater activity in the movements as well as increased secretion, but in disease this practical fact cannot be taken advantage of owing to the irritation which is set up by the solid substances.

As a **preliminary,** therefore, to the study of **stomachics** in their general relations, it will be well to examine briefly the **influence** which the **liver** exerts upon this important function, and we shall thereby familiarize ourselves with the needs of those suffering from dyspepsia and indigestion who seek our services. It will be necessary to recall the fact that the blood which supplies the stomach is carried to the liver by the portal vein, and that by the same route the blood-supply of the intestines also reaches that organ. Whatever diseased conditions of the liver interfere with the circulation in both stomach and intestines, has the effect of interrupting their functions just the same as the failure in the blood-supply of the brain. The **portal circulation** being inactive, venous congestion follows in the stomach, and, as a consequence, digestion goes on but slowly. The old method of giving **purgatives** was generally attended with **good results** temporarily, because, by increasing the secretions of the stomach and intestines by the exhibition of irritants, a considerable portion of the water of the blood was carried off, and this being replaced by a better quality, the patient imagined that he had obtained relief.

In cases of **portal congestion** it would be well to study the condition of the liver, and, if possible, create a more active circulation of that organ, and it is not too much to anticipate that, with this adopted as a rule of practice, the seeming **demand** for **stomachics** would gradually disappear. There ought to be a more physiological method of regulating the portal circulation than by the indiscriminate use of purgatives.

In connection with the administration of stomachics, the function of the liver should be studied, and we should not omit the use of appropriate **hepatic stimulants,** giving suitable cholagogues or laxatives when required to aid in removing the accumulations of bile from the intestine. Hepatic stimulants are remedies which increase the power of the liver to secrete bile, but they do not increase at the same time its power to discharge the same, and, as a consequence, it may be re-absorbed, and this process being continued, the organ becomes exhausted, as it cannot well continue to secrete the bile which ordinarily occurs, and do double duty in re-excreting from the blood the bile which may have passed through it several times already. One of the **functions** of the **liver** is to remove from the blood daily a large quantity of bile, the greater part of which ought to find its way into the intestine. A part of this excretion will be diverted by intestinal digestion; another portion will be required to combine with the discharges from the bowel, and will modify peristalsis; but a third

portion remains to be carried back to the liver, to be again excreted, and again pass through the same process. This covers the excretory function of the liver simply, and it is not deemed necessary here to enter upon a discussion of the glycogenic function of the organ, as, with proper attention to excretion, that will generally require little attention.

Having now considered the influence exerted upon the functions of the stomach by the condition of the liver, and the advisability of taking that organ into consideration when deciding upon the selection of suitable stomachics, it will be appropriate to discuss the general application of the class of remedies which heads this chapter. Bearing in mind that the **secretions** are of the **utmost importance,** in the administration of drugs it should be the first consideration, as under no circumstances would it be advisable to give remedies to a sick person which would interfere with the normal secretion of gastric juice. This matter is of special value in the case of elderly people, and in those who have been complaining for some time, and whose stomachs we may assume are lined with an impervious coating of mucus. Of course this does not apply to those cases in which the secretion is enormous, but where digestion is still below par. In such instances it is our duty to overcome this tendency by the exhibition of astringents and by regulating the diet of the patient, with a view to increase the nutrition.

To establish a **healthy condition** in respect to secretion, there can be no doubt of the value of the class of remedies known as the simple bitters. Where we desire to obtain an effect upon the nervous system, it will be appropriate to add nux vomica or its salt, strychnine; and when there are evidences of lack of a proper secretion, pepsin may be added with the expectation that at least temporary benefit will follow. A convenient combination of this character will not only include the various preparations which have been mentioned, but will also cover the use of hydrochloric acid.

The **popular errors** as to the appropriate time for the exhibition of **acids and alkalies** require some attention in this connection, and as a preliminary step it should be understood that the choice of either does not depend upon the caprice of the physician, but upon the physical condition of the patient. Doubtless the inefficiency of many remedies can be traced to their inappropriate use, but of none is this more true than with acids and alkalies. Some writers and teachers would have us believe that their administration was simply a matter of taste, but the fact remains that many patients will fare much better and recover more rapidly without the use of either acids or alkalies, when there is no **positive indication** for them. In deciding upon this question, therefore, the physician should ask himself if he can by any means increase the acid

condition of the system by the exhibition of alkalies before meals. Admitting that for once, or for several times, this method will be attended with good results, is it reasonable to suppose that the constant use of alkalies will conduce to establish an acid condition? To this question the reply must be negative; and, however much we may admire the **theory of osmosis,** we cannot gainsay the fact that the continued use of either of these remedies tends to the perpetuation of the very disease they were intended to eradicate. The use of **alkalies** has been so general amongst the profession that the laity has taken up the strain, and when the stomach has been exhausted the physician tells them kindly, but firmly, that too much alkalies has led to their discomfiture. On the other hand, the popular use of **acids** in the form of proprietary and other preparations may possibly have something to do with the numerous cases of dyspepsia that come into our hands for treatment, besides the great army of fault finders who contribute to enrich the coffers of liberal advertisers of nostrums.

Sufficient has been said to indicate to the student that these remedies **possess a value** which is to some extent dependent upon conditions inherent in the changeable relations of the human system, and if the matter has been impressed upon the mind of the reader that these **functional disturbances** must be taken account of, the authors will feel that their task has not been undertaken in vain.

Stomachics.—Tonics.

Absinthe.	Cusparia.	Nitric acid.
Calumba.	Gentian.	Nitro-hydrochloric acid.
Cascarilla.	Hops.	Quassia.
Chiretta.	Hydrochloric acid.	
Cinchona bark.	Salts of iron.	Sulphate of beberine.
Nux vomica.	Strychnine.	Sulphate of quinine.
Pancreatin.	Pepsin.	Ox-gall.
Papain, or Papayotin.		
Aloes.	Rhubarb.	Taraxacum.

Stomachics.—Stimulants or Carminatives.

Allspice and oil.	Cloves and oil.	Mustard.
Anise and oil.	Coriander and oil.	Nutmeg and oil.
Asafœtida.	Dill and oil.	Oil of cajuput.
Capsicum and chillies.	Ether and Acetic ether.	Pepper.
Caraway and oil.	Fennel.	Peppermint-oil.
Cardamoms.	Ginger.	Spearmint-oil.
Chloroform and Camphor.	Horse-radish.	Valerian and oil.
Cinnamon and oil.	Mace.	

Stomachics.—Sedatives.

Arsenic in small doses.	Citrate of ammonia and Bismuth.	Opium and its preparations.
Arsenite of copper in small doses.	Creasote.	Oxalate of cerium.
Belladonna.	Henbane.	Oxide of silver.
Bicarbonate of potash.	Hydrocyanic acid (dilute).	Solution of potash.
Bicarbonate of soda.	Mercury bichloride.	Solution of soda.
Carbolic acid.	Naphthol.	Stramonium.
Carbonate, Subnitrate, and Oxide of bismuth.	Nitrate of silver.	Sulphocarbolates.

HEPATIC STIMULANTS AND SEDATIVES.—Not a little controversy has taken place regarding the effect of different drugs upon the liver. Certain remedies which have been vaunted as active hepatic **stimulants** by the clinician have been shown by the experiments of physiologists to act as **sedatives.** The action of **calomel** has always been a contested point, and, as this drug has been largely used by the participants on both sides of the subject, and with satisfactory results, each appears to have a valid claim for precedence. We cannot enter upon this discussion further than to say that there is a strong probability that the contestants do not take into consideration all the bearings in the case, as it is now admitted on the authority of Michéa, and confirmed by Golding Bird and Simon, that the **coloring** of the **stools** after the administration of calomel is due to the presence of **biliary pigment,** although it was claimed by Stillé that this coloration resulted from the formation of the subsulphuret of mercury. But even then the evidence is inconclusive, from the fact that the liver discharges daily into the bowel not less than a quart of bile, and calomel taken by the stomach must therefore come into contact with it. As a simple purgative, then, calomel may favor the excretion of bile, and in this manner the action of the liver may be increased. It may also be increased through the presence of the drug in the hepatic circulation, and, while calomel may have a sedative effect from its mere presence in the organ, its function in respect to the secretion of bile may be increased, and, with the added purgative effects which are admitted, calomel becomes an active agent in the removal of bile from the system.

Corrosive sublimate is an agent which increases the secretion of bile, and calomel may possess some of its properties by reason of its passing through the acid juices of the stomach, and probably on this account Dujardin-Beaumetz has suggested a combination of the two.

From a clinical stand-point, **ipecacuanha** is one of our best hepatic stimulants, but without due attention to the condition of the bowels it will not show as good results as many other drugs which possess purgative properties. The custom of the late Milner Fothergill was in keeping

with this suggestion, and his high opinion of this drug was doubtless due to the fact that along with its exhibition he invariably made it a practice to keep the bowels in a good condition by the administration of suitable doses of **aloin.** Ipecacuanha has a sedative action upon the liver similar to that which it has upon the general system, as those who have taken it know to their sorrow, but the fact is incontrovertible that its appropriate use will often have the best effect upon the general system, and this may be secured without the use of massive doses.

The **cumulative action** of drugs is often due to their tardy elimination by the liver. When to the normal functions of the liver there is added the conversion of ptomaines and leucomaines and extractives, the activity of the **hepatic cell** is exhausted, so that, when sickness comes and additional work is imposed upon it by the administration of alkaloids and other medicines, the whole organism is depressed, and **caution** is necessary in the administration of remedies under such conditions. Especially is this true with respect to such drugs as **acetanilid,** which destroys the integrity of the red blood-corpuscles. The eminent success of physicians in days gone by was due to their timely use of **purgatives,** and thus the accumulation of poisonous products in the alimentary canal was avoided; and it would be far better to-day if, instead of giving many drugs, which we do, that we should remember the function of the liver, and relieve that organ from the performance of unnecessary work.

Concerning the effect of **alkaloids** upon the liver, it should be noted that those of the **solanaceæ,** which include dulcamara and capsicum, and possibly others, are but tardily eliminated. The untoward symptoms following the administration of **atropine** and **duboisine,** even in moderate doses, indicate that these alkaloids may also be included in this category. A similar condition of affairs occurs when other drugs accumulate in the liver, but it should be mentioned that the **method** of **administration** has something to do with this matter. The experiments of Paganuzzi, of Padua, confirmed as a fact what had long been entertained as a suspicion in regard to the **elimination** of **iron** preparations. When introduced into the economy by intravenous injection iron is wholly eliminated by the kidneys, but when taken into the stomach excretion takes place through the liver. It is in this organ, therefore, that we may expect to find **evidences of poison** which has been swallowed, such as lead, arsenic, or other substances, and doubtless it is often the case that a "**torpid liver**" may be due to the innocent administration of drugs which have interfered with the normal functions of the hepatic cell.

A word may be added to show the **value** of the **liver** as an active agent for the **destruction of poisons** which may be introduced into the system.

Certain alkaloids, when administered hypodermatically are very active poisons, but when taken into the stomach they are carried to the liver, and apparently lose their virulence. **Cadaveric alkaloids,** or ptomaines, are not only found in those who have died from various diseases, but they may be formed in the intestine from the decomposition of the refuse matter which should have been carried off by the bowel; but by a wise provision of nature, when carried to the liver, they are **destroyed,** and the products thus formed are excreted through the kidneys. Knowing, then, that this function of the liver exists, we are prepared to understand that it can be overworked, and that there will be a time in the period of **grave affections,** like cholera, yellow fever, and typhoid, when this function will be suspended for a time, and it is then that the depressing effects of these poisons are seen. For a long time this property of the liver was not understood, but it is now too well known to be overlooked in the treatment of such diseases as have been mentioned, as well as others of like character, and it should not be forgotten in the administration of alkaloids hypodermatically.

In the course of a clinical lecture upon the Philosophy of Hepatic Affections,* Aulde has advanced the following suggestions: What the kitchen is to the hotel the liver is to the body. If the food is improperly cooked the guests make serious complaint to the landlord, and he in turn enters complaint against the superintendent of the culinary department. You can well understand how this state of affairs comes about. One says the meat is underdone, another that it is overdone, while a third complains about the quality of the pastry; a fourth suggests an improvement in the hash, so that the entire system is threatened by the friction set up in this particular department.

The **liver** is possessed of a **double function:** It is a secreting gland, but it also performs a function which is in the nature of excretion. If these different functions are not properly and promptly attended to, there will be **friction.** The complaints will manifest themselves in various ways and at various times. Probably the first to complain will be the digestive system. **Intestinal dyspepsia** is set up, and immediately there follows headache and languor, lack of ambition, and unwillingness to long continue at any particular piece of work. The **demon of unrest** takes possession of the mental faculties, and, as a compromise, the physician at once advises his patient to recuperate by taking a trip to the sea-shore or the mountains, believing that good will be accomplished by a change of scene, new friends, and new surroundings. Freedom from care and a change of diet will often work wonders. The exhausted nervous system takes a new lease, and the functions of the liver are

* Medical Bulletin, vol. x, 1888, p. 312.

performed more nearly perfect than when the patient was suffering from the effects of general depression, sometimes called **neurasthenia,** although better known as nervous prostration. Derangement of the function of the liver is frequently responsible for this new disease, which has lately been injected into our modern nomenclature, and the distressing mental condition of the hotel-keeper corresponds very well with the situation of a patient who unfortunately becomes the victim of liver troubles.

After dyspepsia comes **melancholia,** and even mania; then follow heart and kidney disease, often as a result of impurities in the blood, and the sufferer becomes a burden to himself and friends.

From what has been said, it will be apparent that we should have remedies which increase the secretion, as well as remedies which increase the excretion of bile; but, with our present knowledge of pathology and pharmacology, it is impossible to determine with any degree of **certainty** the true position of many drugs which affect the function of the liver, and this difficulty is not diminished when we remember that many, or, in fact, most of them, cannot be used during a course of illness without setting up **irritation.** This is an objection which must always be considered, but by diminishing the dose, as, for instance, in the use of **podophyllum,** that difficulty may be measurably overcome.

In **experimental investigations** the liver has received a degree of attention to which its importance entitles it, but, notwithstanding these observations, it is a fact that the deductions of **physiologists** do not corroborate the observations of the **clinician,** and due allowance must be made for **errors** connected with experimental methods. The observers themselves are often at variance with each other. Thus, according to Röhrig, the **cholagogues,** in the order of their excellence, are as follow: Colocynth, jalap, aloes, senna, and rhubarb. On the other hand, Rutherford and Vignal estimate the excellence of cholagogues in the following order: Podophyllin, rhubarb, aloes, colchicum, and senna. As the character of the work will not permit a full and complete consideration of the subject, it has been deemed advisable to present several tables, the headings of which will fully explain themselves. With the exception of the first table, which has been adapted from the excellent work of Dujardin-Beaumetz on "Diseases of the Liver," these lists have been prepared more for the purpose of indicating, to a limited extent, the various drugs which may be used in the treatment of affections of the liver, with a view to **increase** or **diminish functional activity.**

Co-efficients expressing the absolute **quantity of bile** obtained in each experiment during one hour per kilogramme of the weight of the animal:—

Aloes, 0.69, 0.93; without bile, 0.69.
Baptisin, 0.29, 0.39.
Benzoate of ammonium, 0.54.
Benzoate of sodium, 0.64.
Colchicum, 0.20, 0.45.
Colocynth, 0.27, 0.45.
Corrosive sublimate, 0.47, 0.55, 0.72, 0.85.
Euonymin, 0.46; without bile, 0.47.
Hydrastin, 0.28, 0.32, 0.38.
Ipecacuanha, 0.38, 0.55.
Iridin, 0.63.
Jalap, 0.29, 0.35.
Juglandin, 0.32.
Leptandrin, 0.27, 0.31.
Nitro-hydrochloric acid, 0.39.
Physostigma (ext.), 0.36, 0.75.
Phytolaccin, 0.29, 0.47.
Podophyllin, with bile, 0.01; without bile, 0.47.
Potassium sulphate, 0.47.
Rhubarb, 0.32.
Rochelle salt, 0.33.
Salicylate of sodium, 0.56, 0.66, 0.89.
Sanguinarin, 0.30, 0.40, 0.46.
Sodium sulphate, 0.25, 0.38.

The following two lists are added of remedies which are regarded as **hepatic stimulants**, those in the first column being considered the more active from the stand-point of the experimental physiologist:—

Acid, dilute nitro-hydrochloric.
Aloes.
Benzoate of soda.
Colchicin.
Colocynth.
Euonymin.
Mercury bichloride.
Ipecacuanha.
Iridin.
Phosphate of soda.
Phytolaccin.
Podophyllin.
Salicylate of soda.
Sanguinarin.

Baptisin.
Benzoate of ammonium.
Hydrastin.
Jalap.
Juglandin.
Leptandrin.
Rhubarb.
Rochelle salt.
Sulphate of potassium.
Sulphate of soda.

Medicines which modify the **glycogenic function** of the liver:—

INCREASE:	DIMINISH:
Amyl nitrite.	Antimony.
Nitro-hydrochloric acid.	Arsenic.
Sodium bicarbonate.	Opium and its alkaloids, Morphine and Codeine.
	Phosphorus.

Medicines which affect the liver, and thereby increase or diminish the **formation of urea**:—

INCREASE:	DIMINISH:
Ammonium chloride.	Alcohol.
Antimony.	Colchicum.
Arsenic.	Opium (Morphine).
Iron preparations.	Quinine.
Phosphorus.	

ERRHINES, OR STERNUTATORIES.—These are remedies introduced into the nasal cavity for the purpose of causing **sneezing**, but at the present time they have but a limited use, as their action does not accord with the methods of treatment now in vogue. In addition to the list of remedies given below, there are numerous drugs in the form of powder which, when allowed to float in the atmosphere, will produce this effect. Their **general action** is that of a cerebral stimulant, and with a view to increase mental activity they were formerly much used, snuff being the representative of the class. The rise of blood-pressure which they occasion renders them **unsafe** in the case of elderly persons, and in those who are subject to hæmorrhage, and prolapsus uteri or hernia distinctly contra-indicates their application.

The **indications** for sternutatories may be summed up in a few words as follows: In the case of deafness due to a catarrhal condition of the Eustachian tubes, and in persistent headache accompanied by dryness of the mucous membranes, and also in the case of obstinate hiccough, but experiments of this nature should always be conducted with caution. Years ago it was considered good practice in **obstetrics**, when there was a lack of uterine activity, to administer to the patient by means of a quill a large dose of snuff, which produced violent sneezing with expulsive efforts, and thus hastened delivery, but of course such cases should be confined to those in which there is no obstruction to the delivery, the sole cause being uterine inertia.

It may be mentioned in passing that the principle upon which these agents were formerly given is an important one, from the fact that by their use we are enabled to secure **increased secretion** of the mucous membranes, and are thus able to relieve conditions which are difficult by other local measures, but in pilocarpus we have a valuable substitute, and it may be given internally in such a manner that the results will be apparent within twenty-four hours. This class of remedies is therefore closely **allied to sialagogues**, and should be brought to our aid for the relief of catarrhal conditions affecting the upper air-passages. By combining them with suitable **antiseptics** and with cocaine the action can be had upon the tissues without the objectionable feature of sneezing, which is their characteristic. Sternutatories should be used in the form of powder.

Euphorbium.	Sassy-bark.	Veratrum album in powder.
Ipecacuanha.	Subsulphate of mercury.	
Saponine.	Tobacco (Snuff).	

PULMONARY STIMULANTS OR EXPECTORANTS, AND PULMONARY SEDATIVES.—These are two distinct classes of remedies which affect the pulmonary mucous membranes. The **properties** they

possess and the **objects** for which they are administered may be stated as follows: Pulmonary stimulants or expectorants are remedies which affect the mucous membrane of the respiratory tract and as a rule increase the secretion thereof. A subdivision has been made in order to separate those which are **stimulant** in their action from those which are **depressant** or sedative in their action upon the general system. Pulmonary sedatives are also remedies which affect the mucous membranes of the respiratory passages, but their tendency is to diminish the secretion, and, as a matter of course, they are for the most part anodynes, or remedies which produce a narcotic effect, or they may act through their influence upon the respiratory centres.

In view of the **intimate relations** existing between the two classes of drugs belonging to this series, it has been deemed best to consider the subject in a general way, but as a preliminary to this study it should be stated that the **value of expectorants** as such has been largely overestimated, and it would be well before taking up these drugs seriatim to inquire if this method of treatment has not been overdone in the past. Certainly the number of people who are familiar with the best **cough-drops** and **cough-mixtures** would indicate that every man is his own doctor, and the result is that these knowing ones are the first to experience the lack of appropriate treatment, and many of the cases of sudden death have been due to the disposition of the laity to take kindly to their neighbors' prescriptions for a "cough."

Cough furnishes the **first** indication of the need for an **expectorant,** but when we remember that cough may be due to an acid condition of the stomach, or to engorgement of the liver, or to some obscure heart complication, to congestion from exposure to cold, or to local irritation of the pharynx, larynx, trachea, or bronchi, or that night-cough may be due to an elongated uvula, or to the presence of a circumscribed chronic pneumonia, or to other causes, such as nervous cough, which need not be referred to, it will be apparent that **discretion** must be exercised in the selection of the combination which is best calculated to relieve the pathological condition. But this does not cover the principal **objection** to the use of cough-mixtures, which in the main, as a general rule, are calculated to do more harm than good. **Alkalies** are usually selected for the active ingredient, and as soon as the physiological effect is shown by the presence of a profuse secretion, the patient is encumbered with the necessity for giving that condition of the system the most careful attention. What physician would think of giving his patient a sufficient amount of pilocarpus to cause profuse **diaphoresis,** and send him immediately out into the wintry air? And yet the same principle is carried out daily during the winter time, in all temperate climates, in the treatment of **coughs and**

colds. The vitality of the whole system is depressed, but more especially that of the affected tissues, and unless the patient is possessed of unusual physical strength an attack of illness will naturally follow this method of treatment. Delays may occur to prevent, or a trip for the general health may aid, nature in throwing off the morbid condition, but unless this is effected the time will come when the patient must pay the penalty.

These remarks, however, are not intended to apply to those cases which have passed the **acute stage,** in which the secretions have become tenacious, but to those cases which are in the formative period, and which can be aborted. The **abortive treatment** of colds consists in first removing all extraneous causes which may combine to continue their deleterious influences, such as exposure, lack of suitable clothing, and the want of proper food. Medicinal treatment will include attention to the condition of the skin, the kidneys, and the bowels, with the use of aconite, gelsemium, veratrum, or other suitable remedy to reduce the activity of the circulation and overcome any tendency to fever. As soon as that has been properly effected the patient should be placed under the influence of **quinine** and the **sulphide of calcium,** so that within twenty-four hours he will be fully charged with both remedies. When there is cough, it may be met by the frequent administration of morphine in small doses, not more than one-fiftieth of a grain, at intervals of an hour, or even less for a few hours.

The **secretions** of the bronchial tubes are **modified** by cold, and cough in the first place is due to passive congestion in the venous capillaries,—a condition which will right itself as soon as the active circulation is brought under control. This latter will be accomplished by the measures just indicated, and the exhibition of quinine will prevent the further extension of the inflammatory process, while the sulphide of calcium acts to prevent the inspissation of the mucus thrown off after the subsidence of the more acute symptoms.

When it is desired to increase the secretion of the pulmonary mucous membrane the **alkalies** are excellent, but they should **not** be too **long continued,** owing to the depressing effects which have just been mentioned. As soon as the secretion is freely loosened, **acids** should be permitted to take their place, and the use of **antiseptics** in the form of vapors of different substances will be found efficient, whether we accept the germ theory and the contagious character of pneumonia or not. Numerous **remedies** are of **value,** according to the special indications, as the carbonate of ammonia when the heart is weak, turpentine or terebene if the secretions are especially tenacious, and the stimulating action of these remedies is also desired upon the kidneys. For **children,** some saccharine substance in the form of syrup must be added, and its value

is likewise apparent in the treatment of adults, while the use of the **balsams** will materially add to the efficiency of various cough-mixtures. Occasionally it will be found that **tar,** either in the form of pill or as the wine of tar, will exercise a favorable influence upon the secretion without causing much depression; and where there are indications of a spasmodic condition in respect to the cough, or as manifested in attacks of shortness of breath, a small quantity of **nitroglycerin** added to the tar preparation will prove acceptable.

Some of the remedies which act as pulmonary sedatives do so through their **sedative** action upon the **respiratory centre,** but for the most part they all decrease the secretions, although belladonna **stimulates** the respiratory centre; but, nevertheless, it also, like morphine, lessens the secretions. Great benefit may be obtained from these drugs without producing the narcotic effects. **Apomorphine** and **pilocarpine** are the most active expectorants, and the former, used in **small doses,** is one of the best, although it should be given with due regard to the increased secretion it causes. In this respect it is far superior to pilocarpine, owing to the possibility of the latter producing an undue amount of secretion, so that it cannot be expectorated; but this can be avoided by using the alkaloid in small doses, and discontinuing the remedy from time to time as the demand for it ceases.

As **adjuncts** to the treatment of the class of affections for which pulmonary sedatives and stimulants are indicated, several important factors may be mentioned, as follows: Vascular tonics, appropriate method of breathing, the avoidance of draughts, and the adoption of suitable clothing for the season, and, where there is profuse secretion to interfere with respiration, emetics, the latter being of prime importance in children.

Pulmonary Stimulants or Expectorants.

STIMULATING EXPECTORANTS.

Acids.	Carbonate of ammonia.	Squill.
Ammonia.	Cod-liver oil.	Storax.
Ammoniacum.	Copaiba.	Sulphur, Calcium sulphide.
Asafœtida.	Galbanum.	Tar in various forms.
Balsam of Peru.	Grindelia robusta.	Terebene.
Balsam of Tolu.	Larch-bark.	Turpentine.
Benzoate of ammonia.	Myrrh.	
Benzoic acid.	Saccharine substances.	
Benzoin.	Senega, Saponine.	

SEDATIVE EXPECTORANTS.

Alkalies.	Iodine.	Quebracho.
Ammonia.	Ipecacuanha.	Sulphur oils, Onion, Garlic.
Apomorphine.	Lobelia.	Tartarated antimony.
Carbolic acid.	Oxide of antimony.	Vapor of water.
Chlorine.	Pilocarpus.	
Creasote.	Potassium iodide.	

PULMONARY SEDATIVES.

Acetate of lead.	Hydrocyanic acid.	Opium.
Belladonna.	Hydrocyanic acid (vapor of).	Stramonium.
Conium.	Morphine.	Stramonium (in smoke).
Conium (vapor of).		Tobacco (in smoke).

Spasmodic Asthma.—Asthmatic attacks and expectorants are so intimately related that it seems desirable to make some remarks concerning the pathology in this connection, and we have selected the substance of the following observations from an article which was published during the past year in the *Medical Register*, and clinical experience justifies the position we then assumed.

At present **three views** are in vogue to account for the **asthmatic paroxysm,** as follow: The theory of **bronchial spasm,** the theory of **spasm of the diaphragm,** associated or not associated with other ordinary or extraordinary muscles of respiration; and, lastly, the theory of **constriction** of the **bronchial tubes** by swellings of an hyperæmic, herpetic, or urticaria-like character. Regarding these various views, a word of explanation may be added. The existence of a **muscular structure** in the bronchi has been demonstrated, as well as the contractile power of this muscular structure, and originally the theory of bronchial spasm was based upon the facts brought out by this investigation. For many years this was the **accepted doctrine,** notwithstanding the evolution of other theories, said to be of a purely speculative character, advanced by Todd, Brée, Budd, Walshe, and others. It was indorsed by Reisseissen, Prochaska, Kolliker, Williams, and Longet, and apparently confirmed by the subsequent experiments of Paul Bert, although in his time it was controverted by Laennec. It was called by Willis the "asthma convulsivum," and the bronchial-spasm theory was adopted by Cullen, Romberg, Bergsen, Trousseau, and by Henry Hyde-Salter, the latter being the author of an exhaustive work upon the subject which has generally been accepted as a standard by later authorities. Wintrich, in 1854, and Weber, in 1872, attacked and made serious inroads upon this theory, and in the latter year Leyden claimed to have discovered certain **crystals** in the **sputa** of asthmatic patients which he regarded as responsible for the development of the affection. Leyden's theory, however, was short-lived, as it was found that these crystals accumulated when the expectorated matter was permitted to stand, and soon thereafter it was shown that these crystals might exist, the patient at the same time being free from asthmatic attacks (Pfuhl). Biermer, in his criticism, has pretty effectually refuted the theory of spasm of the **diaphragm,** advocated by Wintrich, and Weber's view, that asthma was the result of **vasomotor** derangements, accompanied by sudden congestive thickening of the bronchial mucous membrane, is a modifica-

tion of that which had previously been advanced by Traube. The old supposition that asthma was due to "**striking in**" of cutaneous eruptions, and revived by Waldenburg, is in direct relation with that of Weber and Traube, although Gedding says "it has found but few advocates among intelligent physicians in America." As a warm advocate of the bronchial-spasm theory, we may mention the name of Professor Fraser, of Edinburgh, to whom we are indebted for many of the foregoing references;* but, before referring to the **weak points** in these theories, we have to note the appearance of a fourth, which bids fair to attract considerable attention, at least amongst those who are devoting their time to the treatment of throat affections and allied disorders.

The **fourth theory**, which is offered by Professor Bosworth, of New York, as a cause for the appearance of asthmatic attacks, is "that a large majority, if not all cases of asthma are dependent upon some obstructive lesion of the nasal cavity," and may justly be set down as the evolution of a specialist, by reason of his opportunities for studying this class of cases. We do not mean by this that we would undervalue his work, nor speak derogatorily of his discovery, but simply wish to indicate that such conclusions are to be looked upon as the natural outcome of his observations, and the array of cases which he offers furnishes most conclusive evidence of the correctness of his therapeutic diagnosis. Dr. Bosworth gives a tabulated account of **eighty cases**, the majority of whom were males, treated mainly by the insufflation of **cocaine**, and with marked success. His cases are divided into two classes, those affected with what he terms "**hay asthma**," and another class subject to "**perennial asthma**," all of whom were treated in the same way, as he believes that both affections are dependent upon similar pathological conditions, designated as **vasomotor rhinitis** and **vasomotor bronchitis**; and yet, strangely enough, he speaks disparagingly of the theory that these attacks are or may be due to reflex disturbances. He says: "The subject of '**reflexes**' has always seemed to me as a term oftentimes used as a cloak to conceal our ignorance of the direct relation between cause and effect, but I am convinced that in very many instances of morbid symptoms, occurring as a result of reflex disturbance, we can offer a more reasonable explanation than reflex in the sense in which reflex is so often used at the present day."

Unfortunately, Dr. Bosworth has fallen into the same pernicious circle of reasoning that brought about the failure of Weber's theory, which is more nearly correct than any of the others, although all of them have some features worthy of consideration. The great **difficulty** in the way of further progress will be more fully understood by quoting the

*American Journal of the Medical Sciences, October, 1887.

following from our author: "Under the influence of this vasomotor paralysis there occurs, from some cause, a sudden letting up of the **control** which is exercised over the calibre of the **blood-vessels,** whereby they become **distended** to such an extent as markedly to interfere with the passage of the air through the bronchial tubes." It will be noted that no mention is made of the particular blood-vessels affected in this manner, and if we could determine whether it were the **arterial** or **venous** capillaries which are so distended it would mark an important step in advance. This question we shall proceed to investigate.

In the discussion of the question relating to **vasomotor paralysis,** by which it is claimed that the blood-vessels become distended to such an extent that the passage of the air through the bronchial tubes is interfered with,—a supposition which is rather **too indefinite,**—it will be convenient to study the various theories which have been offered to account for the **asthmatic paroxysm.** We are not prepared, however, for this study, without some knowledge of the influence exerted by the **respiratory centre,** hence a brief survey of that problem is of paramount importance.

The respiratory centre is **situated** in the medulla oblongata, and extends to the upper part of the cord, and the amount of work performed is largely increased by a venous condition of the blood circulating in it, arterial blood, on the other hand, abolishing its activity. It is still an **unsettled question** whether this stimulation following a venous condition of the blood is due to an absence of oxygen, the presence of carbonic acid, or the products of imperfect combustion. Bernstein asserts that the want of oxygen stimulates the inspiratory, while carbonic acid stimulates the expiratory, centre. At any rate, Brunton says, "As the blood becomes venous the activity of the respiratory centre increases, the respirations becoming quicker and deeper, and the accessory respiratory muscles are thrown into action. This condition is called dyspnœa." Convulsions follow; **excessive venosity** of the blood has paralyzed the nerve-centres, but this may be overcome by adopting artificial respiration.

Now, these conditions may be made to dovetail with our ideas of the **pathological complexus** attending the development of the asthmatic paroxysm, but we must first have a clear understanding of the **vasomotor paralysis** which exists, and the blood-vessels that have become distended in the course of the attack. Furthermore, we must bear in mind the possibility of the bronchial muscles being affected at one time, the diaphragm and other accessories of respiration at another; in other words, the development of the attack is not always attended by the same conditions. Predisposing and neurotic tendencies will exercise an important influence in this matter. Although Professor Bosworth may have met with cases of vasomotor rhinitis and cases of vasomotor bronchitis which

readily yielded to the insufflation of a solution of cocaine, we are not warranted in the conclusion that all cases are amenable to this comparatively mild treatment.

The **bronchial-spasm** theory is **untenable** from the fact that the main difficulty is in expiration; the excessive venosity of the blood may serve to produce an increased tension of the walls of the bronchial tubes by favoring congestion of the mucous membrane, but contraction by a form of spasm is out of the question here as much as in the case of an attack of dyspnœa due to anæmia. It is simply a condition of **increased tension,** due to the distension of the blood-vessels, to which we shall presently refer. In the light of this explanation, the theory of **spasm** of the **diaphragm** also falls to the ground, and if there be any legitimate basis for believing that asthmatic attacks can be produced by the "striking in" of cutaneous eruptions, we may safely assume that it can occur only by reason of the presence of the products of imperfect combustion, as already referred to.

When we come to the subject of vasomotor paralysis, with distension of the blood-vessels as a cause of the asthmatic paroxysm, the **solution** of the **problem** is comparatively easy, from the fact that we can reason from cause to effect. Thus, it is now a well-recognized truth that venosity of the blood will cause **dyspnœa** and **convulsions**; that these effects are due to the action of **impure blood** on the nerve, destroying its function and lessening its control over the muscle which it supplies. The **muscular structure,** being freed from control, exercises its inherent property and contracts. This rule applies no less to the muscular structure of the arteries than to other muscles, and, as a matter of fact, it is found by observation that we have to deal with contraction of the **arterial capillaries,** the venous capillaries being the ones that are suffering from distension during the asthmatic attack. With this condition present the resiliency of the air-vesicles is destroyed; they cannot contract. The **expiratory effort** is thus practically removed, there is a lack of proper aëration, carbonic acid accumulates, and in case there are, in addition, the products of imperfect combustion in the blood, another factor is injected into the pathology of the affection.

Nitroglycerin promptly **relieves** the asthmatic seizure. It does this by acting upon the **arterial capillaries**; their distension is rapidly followed by a re-adjustment of the vascular tension. Patients suffering from attacks of this nature frequently complain of severe **headaches,** which in many respects resemble the "**helmet**" of Charcot; at times they complain of occipital pain, then again frontal, but it may extend to both. Within **one minute** from the time a drop of the 1 per cent. solution of nitroglycerin is taken by the patient this helmet-like headache will dis-

appear, the breathing will become easy, and if the medicine is continued for a time the bronchial râles will gradually become less and less distinct. The inhalation of **oxygen gas** will often have a beneficial effect, and with cocaine by insufflation we need have but little fear that our patient will long be compelled to suffer.

Lobelia has been used successfully in the treatment of these cases, but on account of its depressing effect few patients are willing to take it the second time. **Smoking** the leaves of belladonna, stramonium, hyoscyamus, and even tobacco, with or without the nitrate of potassium, has been found useful, but the **nitrites** taken internally are far more satisfactory, nitroglycerin probably taking the lead, although the nitrite of sodium as well as the nitrite of amyl are used.

The **iodide of potassium** has been very highly recommended, and if we accept the view that asthma may be occasioned by the products of **imperfect combustion** in the blood, its value will be apparent; but it may also be used advantageously when it is desired to remove the products of inflammatory action.

As a remedy, in cases of **neurotic character,** grindelia robusta occupies a prominent position. The fluid extract, given in teaspoonful doses at intervals of three or four hours, will in these cases prove very acceptable.

Atropine, morphine and chloral have all been recommended, but we need not further continue the discussion, as we have already pointed out the **defects** in the **theories** previously held regarding this disease.

DIAPHORETICS, SUDORIFICS, AND ANTIHIDROTICS.—These are remedies which act upon the **sweat-glands,** increasing or diminishing the amount of the perspiration. The first two, diaphoretics and sudorifics, are substantially the same, differing only in degree, the latter term being used to indicate increased functional activity. **Pilocarpine** is the representative of the class.

Antihidrotics are remedies which lessen the secretion of sweat, **belladonna** being the most active of the class. The two remedies just mentioned may be regarded as representatives of the respective classes. It may be mentioned that, as a general rule, the action of antihidrotics is confined to those drugs which stimulate the respiratory centre.

Diaphoresis is generally attended by dilatation of the capillaries and increased activity of the circulation, but this is not always the case, although it has been found that vaso-dilator and secretory nerves accompany each other. Sweating may be produced in **different ways** through the influence of the nervous system. Thus, some drugs, like pilocarpine, will produce sweating when applied locally, or taken internally, through its influence upon the nerve-centres; ipecacuanha and tartar emetic are

supposed to produce diaphoresis **reflexly** through their influence upon the walls of the stomach; alcohol, opium and other drugs cause sweating by their **stimulating** action upon the general system. The effect of mental emotion should also be mentioned.

The **indications** for the use of diaphoretics are daily growing more numerous, and as they act in the way of emunctories of the skin, and thus become **complementary** in their action to the function of the kidneys, we cannot overlook their value, but it is desirable that they should be applied with as little discomfort as possible to the patient. So far as known, it is believed that but little solid matter is carried off through the skin, although the fact is well known that many volatile substances are excreted largely through the cutaneous system.

One of the most important of the **functions** of diaphoretics is that of regulating the **temperature,** but free sweating may occur while the skin is cold. To **abort** inflammatory action, either of mucous or serous surfaces, diaphoretics are of especial value, and since the introduction of pilocarpine for the treatment of erysipelas we must look to that drug for great service to us in all cases where benefit will be derived from free action of the skin. In the case of **fevers,** this drug and others of its class will be found of decided benefit if judiciously employed; in the treatment of **measles, scarlet fever,** and other eruptive affections, the value of pilocarpus will be apparent when there is a tendency of the eruption to subside too rapidly, as shown by the appearance of a cough and an unsatisfactory condition of the patient. Morbid conditions of the **skin** will be improved by the judicious use of pilocarpine and its cogeners, and particularly will this be noticeable if we have to contend with a condition of the system referred to as that of **suboxidation.** **Diabetes** and polyuria often demand the administration of diaphoretics.

Diaphoretics or Sudorifics.

STIMULANT SUDORIFICS.

Alcohol (as wine or distilled spirits).	Camphor.	Pilocarpus.
	Chloroform.	Salts of morphine.
Ammonia, acetate.	Dulcamara.	Sarsaparilla.
Ammonia, carbonate.	Ethers.	Sassafras.
Ammonia, citrate.	Guaiacum.	Senega.
Ammonia, free.	Mezereum.	Serpentary.
Ammonia, nitrate.	Opium preparations.	Sulphur.

SEDATIVE SUDORIFICS.

Antimony, oxide of.	Antimony, tartarated.	Ipecacuanha.

ASSISTANT SUDORIFICS.

Hot vapor to the skin.	Warm diluents.	Warmth to the surface.

ANTIHIDROTICS OR ANHIDROTICS.

Acids.	Ipecacuanha.	Picrotoxin.
Agaricus albus.	Muscarine.	Pilocarpus (Pilocarpine).
Belladonna, Atropine.	Nux vomica (Strychnine).	Quinine.
Hyoscyamus.		Zinc salts.

DIURETICS AND LITHONTRIPTICS.—**Diuretics** are remedies which increase the functional activity of the **kidneys,** either through the influence they have upon the **arterial pressure,** or through their action upon the secreting **nerves** and **cells** of the organ, or both. **Lithontriptics** include a class of drugs which are supposed to possess the power to **change** the character of the **urinary secretion** to such an extent that deposits of crystalline or amorphous substances are prevented, by which means the healthy condition of the kidneys is maintained, or, should diseased products be present, the presence of the remedy in the organ will **effect** their **solution** and subsequent removal. The whole subject is a very **complicated** one, and has been studied with great care by many careful observers, amongst which may be mentioned Heidenhain, Phillips, Brunton, and others; but from the fact that much of the literature must of necessity carry with it the **defects** which attend upon all experimental investigations, as has already been pointed out, we are still unable to determine positively the true **relations** existing between the influence of drugs in **health** and in **disease.**

In placing before the reader the following tabulated lists of remedies, it is believed much benefit will be derived from a careful study of the subject, and by reference to the respective headings a tolerably clear idea can be obtained regarding the most appropriate drugs for the relief of the various affections we are called upon to treat:—

Diuretics, Lithontriptics.

DIURETICS.

Sedative:—	Stimulant:—	Nitrite of ethyl,
Colchicum,	Alcohol,	Turpentine,
Scoparius,	Cantharides,	Water.
Squill,	Copaiba,	The potash, soda, and lithia salts are placed under lithontriptics.
Tobacco.	Juniper,	

INDIRECT DIURETICS.

Caffeine.	Cream of tartar.	Gamboge.
Counter-irritation to loins.	Depletion from loins.	Hydragogue purgatives, as Elaterium.
	Digitalis.	Strophanthus.

LITHONTRIPTICS.

Acetate of potash.	Carbonate of lithia.	Phosphate of soda.
Bicarbonate of potash.	Carbonate of potash.	Phosphoric acid.
Bicarbonate of soda.	Citrate of lithia.	Vichy water.
Benzoate of ammonia.	Citrate of potash.	Other alkaline mineral waters.
Benzoic acid.	Citric acid.	
Borax.		

ACTING CHIEFLY ON THE BLADDER.

Balsam of Peru.	Benzoic acid.	Pareira brava.
Benzoate of ammonia.	Buchu.	Uva ursi.

ACTING CHIEFLY ON THE URETHRA.

Copaiba.	Cubebs.	Turpentine.

The following diagram which has been compiled, it is believed, will materially aid the student in estimating the value of the drugs therein, and at the same time further his interest in the investigation of the clinical value of these as well as other remedies which may be advanced as suitable for the treatment of diseased conditions :—

DIURETICS.

- Increase arterial pressure.
  - Generally.
    - Increase cardiac power.
      - Adonidin.
      - Alcohol.
      - Caffeine.
      - Digitalis.
      - Strophanthus.
    - General effect through vasomotor influences.
      - Adonidin.
      - Caffeine.
      - Cold to surface.
      - Convallaria.
      - Digitalis.
      - Erythrophleine.
      - Squill.
      - Strophanthus.
      - Strychnine.
  - Locally in kidney.
    - Action upon the efferent vessels.
      - Through vasomotor centres.
        - (?) Similar to above.
      - Through local action on renal structures.
        - (?) Broom.
        - (?) Cantharides.
        - (?) Copaiba.
        - (?) Juniper.
        - (?) Turpentine.
    - Action upon the afferent vessels.
      - Action upon vasomotor nerves.
        - Alcohol.
        - Nitrites.
        - (?) Urea.
- Increase activity of secreting nerves and cells.
  - Increase urinary water.
    - Aconite.
    - Caffeine.
    - Calomel.
    - Urea.
  - Increase urinary solids.
    - Potassium and Saline diuretics.

EMMENAGOGUES AND ECBOLICS.—These are drugs and measures which heighten the **functions** of the **uterus** and its appendages; the **first** excites the nervous system and favors the appearance of the menstrual molimen at the regular periods, while the **second** stimulates the uterus to contract. **Direct emmenagogues** are medicines which are supposed to produce their effect through the influence of the nervous system; **remote** emmenagogues include those drugs which affect the general nutrition, as in the case of iron and manganese preparations, as well as those which increase the determination of blood to the pelvic organs, as aloes and other purgatives. **Ecbolics** are drugs which seem to modify directly the uterine contractions, although the circumstances attending the action of the different remedies are essentially different, and therefore a **combination** is often more valuable for this purpose than a single remedy.

The **indications** for the exhibition of this class of remedies may be briefly pointed out as follows: When the condition of the patient shows that the uterine functions are depressed from **anæmia,** as the most common cause for amenorrhœa is an impoverished condition of the blood. Mention should also be made of the fact that anæmia may be found in conjunction with general **plethora,** in which case purgatives are especially indicated, to be followed by ergot in suitable doses and a nutritious diet. There also occurs, not infrequently, **amenorrhœa** dependent upon **malarial cachexia,** in which quinine is of prime importance.

Ecbolics are useful in **uterine congestion,** as well as for their power to cause contraction of the uterus and the expulsion of its contents. In the condition known as **subinvolution** they are especially valuable, but it is needless to say that this treatment should be supplemented by appropriate hygienic measures, and by other means calculated to improve the general nutrition of the patient.

Galactagogues, remedies which influence the **flow of milk,** may be conveniently interpolated here. The most powerful drug of this class is undoubtedly **pilocarpine,** and when properly used it will be found to increase the appetite and improve digestion to an extent which is surprising. The value of **electricity** should not be overlooked, but the difficulties attending its application, together with the transient character of the effects produced, warrant us in assuming that much better results will follow the use of the former remedy. As an **antigalactagogue,** belladonna may be mentioned in this connection, and as adjuvants strong coffee and a dry diet should be insisted upon, although these measures do not require to be long continued.

A word should be added to the effect that medicines when given to **nursing mothers** should always be considered with reference to their effect upon the **child,** as purgatives, opium, volatile substances, and notably salicylate of sodium are excreted with the milk, and will affect the infant at the breast, and cases of **poisoning** from the injudicious use of active medicines have been known to affect the child.

Emmenagogues and Ecbolics.

DIRECT EMMENAGOGUES.

Asafœtida.	Ergot.	Quinine.
Castor.	Guaiacum.	Rue.
Cimicifuga.	Hydrastis.	Savine

INDIRECT EMMENAGOGUES.

Aloes.	Counter-irritation,—leeches, mustard	Manganese.
Colocynth.	Electricity.	Potassium permanganate.
Other strong purgatives.	Iron.	Strychnine.
Baths.		

ECBOLICS.

Belladonna.	Electricity.	Quinine.
Borax.	Ergot.	Savine.
Cimicifuga.	Galactagogues.	Thuja.
Coffee.	Hydrastis.	Tea.
Digitalis.	Pilocarpine.	Volatile oils.

APHRODISIACS AND ANAPHRODISIACS.—The proper performance of the **sexual** act depends to such an extent upon the general **physical condition,** aside from the special diseases to which individual patients may be subject, that we shall undertake here only a superficial consideration of the subject, and mainly from the stand-point of the general practitioner in his daily work. That this matter deserves more general consideration at the hands of physicians is evident from the numerous flaming advertisements in the daily prints. A large proportion of those coming under the malignant influence of quacks would receive far more advantage from the institution of **hygienic reforms** and **mental encouragement** than from drugs which, in the absence of mental and moral stamina, are practically worthless.

In addition to the **careful** administration of the drugs named below, there are some general **observations** which it will be advisable to take into consideration. The condition of the **bowels** should be regulated by the selection of an appropriate dietary rather than by the exhibition of laxatives or purgatives, although their use is not contra-indicated as a preliminary to treatment. The specific gravity and reaction of the **urine** must be investigated with a view to remove local complications. The condition of the **mucous membranes** of the rectum and bladder must be determined, and in case of hæmorrhoids, cystitis, or stone in the bladder, of course, all such exciting causes should be removed. Those remedies which are regarded as direct aphrodisiacs should always be exhibited in **small doses,** as their value depends largely upon the power they possess to increase nutrition.

Aphrodisiacs and Anaphrodisiacs.

DIRECT APHRODISIACS.

Cantharides.	Nux vomica.	Phosphorus.
Ergot.	Opium in small doses.	Strychnine.
Indian hemp.		

INDIRECT APHRODISIACS.

Blood tonics.	Direct antispasmodics.	Nervine tonics.

DIRECT ANAPHRODISIACS.

Bromide of ammonium.	Camphor.	Iodide of potassium.
Bromide of potassium.	Hemlock (Conium).	

INDIRECT ANAPHRODISIACS.

Alkaline medicines (the continued use of).	Bleeding.	Nauseants.
All vascular and nervine sedatives, as—	Cold baths,—local and general.	Purgatives.

MYDRIATICS AND MYOTICS.—The number of drugs possessing the property of contracting or dilating the pupil is comparatively limited, but they are frequently of signal service in assisting the physician in the matter of general treatment, while their peculiar **physiological effects** afford timely warning to the physician that sufficient has been taken into the system. The effect of **opium** taken with suicidal intent may be determined by the examination of the pupil, and we are thus furnished an indication for the proper treatment, at least from a physiological point of view. **Anæsthetics** act in a double manner; during the early stages of anæsthesia, the stimulating effect of the inhalation causes the pupil to contract, while later on, when to the anæsthesia there is added the narcotic action of carbonic acid accumulations in the blood, the pupil dilates, and serves as a guide to the operator.

Mydriatics are frequently **employed** to relieve tension due to inflammatory action, and with the advantages offered by **cocaine** as a local anæsthetic a more speedy recovery may be promised than could be expected without these means.

Mydriatics.

Anæsthetics, at last.	Gelsemium.
Belladonna, Atropine.	Hyoscyamus (Hyoscyamine).
Cocaine.	Stramonium.
Duboisine.	

Myotics.

Anæsthetics, at first.	Opium (Morphine).
Calabar bean (Eserine, Physostigmine).	Pilocarpus (Pilocarpine).

IRRITANTS.—This class of remedies is well named. Their function is to irritate, and although the generation of physicians now passing away laid great stress upon the use of external applications, the physician of the present seeks rather to avoid their employment by anticipating pathological changes, and thus in a measure preclude their necessity. The dawn of **antiseptic methods,** by which we are almost certain of preventing the formation of pus-cavities, and the knowledge we possess of the value of drugs in modifying pus-formation when discovered, has effected a revolution in methods of treatment. The demands of **modern science,** as well as of modern thought, have exercised a remarkable influence upon medical investigation, and the results attained in the practice

of antiseptic surgery may be accepted as the greatest achievement of the nineteenth century.

It will not be claimed, however, that external applications of this character should be wholly discarded, as within **proper limits** they may be made to serve a valuable purpose, but, like many other methods which are now obsolete, they can frequently be avoided with advantage. Their **abuse**, and not their use, is what we contend against; and with a view to elucidate the subject, the following remarks have been prepared :—

Irritants include a large number of remedies which have for their object the **modification** of **tissue-change** by means of local treatment, which may be either in the form of mild counter-irritation, or from that simple method it may extend to the destruction of the tissues through the application of caustics of different kinds, or the use of the actual cautery. For convenience of study, these remedies are grouped with a view to indicate the effect which may be expected when applied to the tissues of the body.

The first of these groups covers the use of topical remedies called **rubefacients,** which are used simply for the purpose of causing slight redness and irritation, which will be merely temporary, or which may not wholly disappear within several days. They are not applied for a sufficient length of time to cause a solution of continuity of the tissues, nor do they give rise to the accumulation of serum in the underlying parts, as is the case with **vesicants.** The **difference** between these two classes is one of degree, not of kind. When vesicants are allowed to remain in contact with the skin for but a short time they act as rubefacients, and when rubefacients are permitted to continue their action vesication will follow and they thus become **epispastics. Pustulants** are remedies which, when applied to the skin, cause the development of small circular eruptions similar to the eruption of small-pox. The effect of the latter is more pronounced and is deeper than that of the others which have just been named. **Caustics** or escharotics not only act as irritants, but they actually destroy the tissues to which they are applied.

Therapy.—Having now referred in a general way to the action of these different classes, it will be appropriate to consider their value when applied for the therapeutic results which they promise. When we have to deal with **deep-seated inflammations** which cannot be reached by internal treatment, and which do not show an inclination to recovery under the influence of the *vis medicatrix naturæ*, much benefit may be expected from the use of irritants because of the derivative action which follows. An **example** of this may be seen in the treatment of **chronic pleurisy,** when absorption goes on slowly, but after the application of a suitable counter-irritant the process is greatly accelerated. An **explana-**

tion of this increased activity may be found in the fact that by the application of the irritant the quantity of blood circulating in the affected part is greatly augmented, and as a consequence repair is more promptly carried forward. Counter-irritants are to be used with due **caution** on account of the depression which follows, and when there is insufficient **vitality** in the system, and the indications point to the probability of a lack of strength to determine **reaction**, their use will be attended with untoward effects. They are not to be used, therefore, too frequently, and never in cases where depression of the system would lead us to suppose that their use would not be promptly followed by reaction and by improved nutrition of the parts.

Caustics and escharotics are useful in removing unhealthy granulations as well as local excrescences, where the patients are unwilling to submit to a surgical operation, but in the use of **arsenic** locally for this purpose great care must be exercised to prevent absorption by the general system.

Rubefacients.

Alcohol, Chloroform, Ether, } when evaporation is prevented.
Arnica.
Cajuput-oil.
Iodine preparations :—
  Iodide of cadmium,
  Iodide of lead.
Liniments (Compound camphor).
Menthol.
Mezereum.
Mustard locally, or its
Volatile oil, and
Other volatile oils (Turpentine).
Mechanical friction.

Epispastics or Vesicants.

Acetic acid (Glacial).
Cantharides (solution, plaster, etc.)
Euphorbium.
Rhus toxicodendron.
Heat.

Pustulants.

Antimony (tartarated).
Croton-oil.
Silver nitrate.

Caustics and Escharotics.

Acetic acid (Glacial).
Acid chromic.
Acid hydrochloric.
Acid nitric.
Acid osmic.
Acid sulphuric.
Actual cautery.
Antimony chloride.
Arsenic.
Bromine.
Carbolic acid.
Caustic lime, Soda, and Potash.
Copper sulphate.
London paste.
Mercury (Red oxide, Corrosive chloride, and Acid nitrate).
Silver nitrate.
Sodium ethylate.
Vienna paste.
Zinc (Chloride and Sulphate).

LOCAL SEDATIVES.—As contradistinguished from irritants, we have a number of drugs and methods which act upon the tissues locally as sedatives, some of which produce an anæsthetic effect and are properly termed **analgesics.** Aconite when applied locally has the effect of quieting pain, and when applied to contused wounds will materially aid in restoring the normal circulation of the parts. The use of belladonna for the relief of painful swellings is well known; bismuth lessens the irritability of the sensory nerves and thus becomes a pain-relieving agent. The value of ether and other sprays has long been recognized.

External and Local Sedatives.

Atropine.
Belladonna.
Bismuth salts.
Carbolic acid.
Creasote.
Hamamelis.
Hydrastis.
Hydrocyanic acid.
Lead acetate.
Lead, solution of subacetate.

Local anæsthetics:—
- Aconite (Aconitine),
- Carbon disulphide,
- Cocaine,
- Ether spray,
- Ice,
- Rhigolene spray,
- Veratria (Veratrine).

Opium and its preparations.
(Laudanum.)

EMOLLIENTS AND DEMULCENTS.—There is no distinct line of demarcation between these two classes of remedies, although the former name is applied generally to those which are for external use, while the latter are intended for internal administration. We cannot overlook the **value** of external applications of this kind, but a note of warning should be given that they are not to be **too long continued** or they will defeat the very purpose for which they are used. Water dressing in itself is perfectly unobjectionable, and when applied without adding any degree of heat to the parts, much good will follow its use, but the indiscriminate use by physicians and by the laity of poultices, salves and ointments has worked irreparable **injury** to thousands of patients. In disease, whatever most conduces to a return of the healthy function of the tissues should be adopted, but no one who has studied the matter carefully will attempt to deny the injury which is daily brought about by the injudicious use of this class of remedies. The authors have witnessed the most unfortunate results following the continuous use of perfectly harmless (?) poultices on the recommendation of physicians and friends. The more nearly we come to imitating nature in the treatment of affections, both local and general, the greater will be the success which attends our efforts in the cure of disease, and we have no hesitancy in saying that the entire business of external applications has been greatly overdone.

Emollients and Demulcents.

Albuminous and Gelatinous substances :—
- Gelatin,
- Isinglass,
- White of egg.

Oily and Fatty substances :—
- Almond-oil,
- Glycerin,
- Lard,
- Linseed-oil,
- Olive-oil,
- Spermaceti,
- Suet,
- Wax.

Petroleum oils.

Poultices and hot fomentations.

Soap and other liniments.

Starchy and Mucilaginous substances :—
- Bread,
- Collodion,
- Figs,
- Flour,
- Gum,
- Honey,
- Linseed,
- Oatmeal,
- Starch.

Warm water.

LOCAL ASTRINGENTS AND STYPTICS.—These vary but little from astringents already considered. They are variously used for the purpose of **checking** excessive **discharges**, such as ulcers, a normally increased or diseased secretion from mucous membranes, or as an injection in leucorrhœa and gleet; to check hæmorrhage, and to increase the vitality of parts, and frequently for their alterative action upon the cutaneous system.

Acids :—
- Dilute sulphuric,
- Gallic,
- Tannic.

Actual cautery.

Alum.

Catechu.

Iron perchloride.

Iron sulphate.

Kino.

Lead acetate.

Lead carbonate.

Lead subacetate.

Lime-water.

Nutgalls.

Oak-bark.

Rhatany.

Zinc acetate.

Zinc oxide.

Zinc sulphate.

By contraction of the blood-vessels :—
- Digitalis internally.
- Ergot internally.
- The application of cold, as ice.
- The application of heat, as hot water, etc.

Mechanical styptics :—
- Collodion,
- Matico,
- Spider's web.

ANTIDOTES.—Antidotes are used for overcoming the effects of poisonous substances taken into the system either accidentally or with suicidal intent. They are divided into **chemical** and **physiological. Chemical antidotes** are remedies which, coming in contact with the poisons, neutralize their activity by forming with them chemical compounds which are insoluble and therefore harmless. The use of magnesia sulphate in **lead-poisoning** furnishes an example of this action; the lead in the tissues is changed into an insoluble sulphide, and by the use

of an alterative, such as the iodide of potassium, we are enabled to increase the functions of excretion by which insoluble products are eliminated.

Physiological antagonists or antidotes, on the contrary, do not destroy the activity of the poisons, but have a tendency to counteract their effect upon the blood and the nerve-centres, by which means the normal functions are continued, and gradually the effects of the poison disappear. An illustration of this is found in the use of atropine or picrotoxin to counteract the **effects** of **morphine** upon the system. Morphine causes contraction of the pupil, while atropine produces dilatation, and it has been shown experimentally that in other respects they are mutually antagonistic, and that a lethal dose of either may be overcome by the subsequent administration of the other, although when both are given together this result does not obtain, and death will follow. This is undoubtedly a very **interesting study,** and has placed mankind under great obligations to that much-abused class of persons known as experimental physiologists, who have already accomplished so much in advancing our knowledge of **rational therapeutics.**

First in importance in the treatment of cases of poisoning, after having determined the character of the drug which has been taken, is to effect its removal by the use of suitable **emetics,** or by the stomach-pump or by an improvised syphon, although caution is required in the case of active corrosive substances, which may destroy the walls of the stomach, when vomiting would be dangerous owing to the tendency to cause rupture of the organ. **Next in order** comes the necessity for maintaining a healthy condition of the blood and nervous system by means of **artificial respiration,** but as it frequently happens that patients are not seen by the physician early in the attack, at a time when there is great depression of the vital powers, **oxygen inhalations** should be called to our aid. When its administration is not available in this form, the gas may be used by **rectal insufflation.**

The following **list of antidotes** has been compiled in the hope that its study will familiarize the student with the most approved methods to be followed in the more common cases of poisoning which are likely to be met with in general practice. Murrell suggests the following formula as a **multiple antidote*** **:—**

℞ Saturated solution of sulphate of iron, . . .	100 parts.
Water, ...	800 "
Calcined magnesia, ...	88 "
Purified animal charcoal, ...	40 "

* Murrell: "What to Do in Cases of Poisoning." Phila., 1887.

The iron solution is kept separate from the mixture of magnesia and charcoal until wanted, when they should be put in a bottle together and well shaken. This solution may be given *ad libitum*, a wine-glassful at a time.

Antidotes.

Acids :— Acetic, Hydrochloric, Nitric, Oxalic, Phosphoric, Sulphuric, Tartaric.	Magnesia, chalk, and dilute solutions of the alkaline carbonates; soap, milk, albumin, and oils.
Alkalies :— Caustic potash, soda, lime and ammonia, and carbonates.	Vinegar and water, dilute acids and lemon-juice, milk and oil.
Alkaloids generally.	Finely divided animal charcoal.
Gases and vapors :— Ammonia vapor, Bromine, chlorine, iodine vapor, Carbon monoxide, Carbonic acid, (Choke-damp), Charcoal fumes, Coal-gas, Fire-damp, Marsh-gas, Sulphuretted hydrogen.	Vapor of vinegar, steam, and oxygen inhalations, along with the known physiological antagonists; tracheotomy or intubation, rectal insufflation or transfusion, and artificial respiration.
Aconite.	Diffusible stimulants, warmth, atropine, strophanthus, or adonidin hypodermatically.
Alcohol.	Coffee, strophanthus, followed by pilocarpine; catheterization.
Anæsthetics :— Chloroform, ether, etc.	Artificial respiration, atropine, strophanthus, oxygen inhalations, inversion; the use of the battery to stimulate the muscles of respiration.
Antimony.	Emetics, or the stomach-pump, to be followed by tannic or gallic acid, and albumin; milk or white of egg, and demulcents.
Arsenic.	Secure vomiting; wash out the stomach with stomach-pump or a syphon; give dialyzed iron freely, or the freshly precipitated oxide; animal charcoal or magnesia may be used.
Atropine (Belladonna).	Diffusible stimulants and coffee, or caffeine subcutaneously, and morphine, but artificial respiration should be maintained; physostigmine may be used cautiously.
Barium chloride.	Soluble sulphates, magnesia and sodium.
Belladonna.	(See atropine.)
Calabar bean.	Stimulants, atropine, artificial respiration.

Cannabis indica.	Exercise and artificial respiration; the battery cautiously, and atropine.
Cantharides.	Avoid oils and fats; give demulcent drinks, and use catheter.
Carbolic acid.	Stimulants and saccharated lime.
Chloral.	Warmth, exercise, and strychnine hypodermatically.
Cinchona and alkaloids.	Tannic acid and alkalies; iodine preparations form with cinchona insoluble compounds; give morphine for its effect upon the brain, and belladonna for its influence over the heart and sympathetic system.
Colchicum.	Stimulants with tannic or gallic acid.
Conium.	Alkalies and tannic acid are chemically incompatible; strychnine and picrotoxin subcutaneously.
Copper.	Albumin to form insoluble compounds; wash out the stomach; morphine to relieve pain.
Corrosive sublimate.	(See mercury.)
Creasote.	(See carbolic acid.)
Croton-oil.	Emetics and demulcents, followed by stimulants.
Curare.	Ligature, with removal of the infected portion, and allow only a small amount of the poison to reach the circulation at one time; artificial respiration and diffusible stimulants cautiously. Apply caustic alkalies locally. Strychnine and atropine to combat its action on the cord. Oxygen inhalations especially valuable.
Cyanide of potassium.	(See hydrocyanic acid.)
Digitalis.	Tannin, stimulants, perfect quiet in the recumbent posture, with nitroglycerin in the early stages to relax the arterial capillaries, and strophanthus later to maintain the power of the heart.
Ergot.	Same as digitalis, with the addition of transfusion or enema of a saline solution.
Gelsemium.	Diffusible stimulants, atropine and strophanthus, with artificial respiration.
Hydrocyanic acid.	Affusions to spine, hot and cold; ammonia by inhalation, internally and subcutaneously, preferably by intravenous injection; the subcutaneous use of ether with Hoffman's anodyne internally; artificial respiration and oxygen inhalations.
Hyoscyamus.	Same as atropine.
Lead.	Sulphate of magnesia or soda; sulphur baths.
Lobelia.	Stimulants with strychnine or strophanthus.
Morphine (Opium).	Emetics, animal charcoal, strong coffee, artificial respiration, exercise, the battery, and atropine hypodermatically; in case the patient is apparently moribund, nitroglycerin subcutaneously.
Mercury and its preparations.	Albumin; white of egg; demulcent drinks.

Mushrooms.	Castor-oil; atropine hypodermatically and stimulants.
Nitrites:— Amyl nitrite, Nitroglycerin, Sodium nitrite.	Ergot, stimulants, hot and cold douches, digitalis, atropine, artificial respiration.
Oil of bitter almonds.	(See hydrocyanic acid.)
Opium.	(See morphine.)
Phosphorus.	Avoid oils and fats; give French turpentine or that which has stood long and become oxidized; sulphate of copper.
Picrotoxin.	Chloral, bromide of potassium, morphine.
Pilocarpus (Pilocarpine).	Atropine.
Savine.	Soluble sulphates; Epsom or Glauber's salts; demulcents.
Silver nitrate.	Chlorides of alkalies; common salt.
Snake-bite.	Ligature or removal of part infected; ammonia or stimulants, or both; artificial respiration.
Stramonium.	Same as atropine.
Strychnine.	Chloral; the bromides; chloroform inhalations; oxygen inhalations; tannin.
Tobacco.	Strophanthus, stimulants, warmth, and, for its general effect, strychnine.
Turpentine.	Magnesia sulphate and demulcents.
Veratrine.	Diffusible stimulants; caffeine hypodermatically; the recumbent posture.
Zinc sulphate.	Carbonate of soda in solution.

DISINFECTANTS AND ANTISEPTICS.—The value of disinfectants has long been recognized; not so the application of antiseptics. An entire volume might be profitably devoted to the study of the **uses of antiseptics,** and the subject still be left incomplete and unsatisfactory. While much has been accomplished in this direction, the present state of our knowledge is such that our discoveries are of comparatively little value except from a **surgical** stand-point, and in the present article an attempt will be made simply to outline the general character of the **relations** which exist between **antisepsis** and **practical medicine.**

At the outset, therefore, it will be appropriate to consider the meaning of the two terms which have been placed at the head of this section. **Disinfectants** are remedies which are used to destroy the poisons that are essential elements in the spread of contagious diseases, and their use is a tacit admission that diseases are propagated by certain **specific germs.** Koch's discoveries, and the investigations of others who have followed in his footsteps, offer the most convincing evidence that without the presence of these germs the prevalence of many malignant affections

could be materially diminished, if not wholly eradicated, and the success which has attended the experiments of **bacteriologists** within the past few years warrants the assumption that much more will be accomplished from the work that has already been done. **Antiseptics** are remedies which prevent the development of bacteria, and thus arrest decomposition and putrefaction; they differ in some respects from **germicides,** which possess the power to kill these bacteria, which are inimical to life. **Both** classes belong to the more general division of remedies against fermentation known as **Antizymotics,** and it will best serve the purposes of this article to study the subject in connection with a consideration of the life-history of bacteria, including the yeast, the innocuous, and the pathogenic bacteria.

The reasons for lack of successful application of our knowledge of bacteriology in the treatment of disease lies in the fact that these ferments are **less susceptible** to influences which can be brought to bear upon them **inside** of the **body** than when found in exposed situations, as in the practice of **surgery.** Being distributed throughout the entire system, even in health, it is practically impossible to reach them by any remedies known which will not at the same time exert a deleterious effect upon the human tissues; and were it not that nature has furnished **means** for their **destruction,** no living person could long withstand their mephitic influences. **Bacteria** are found in large numbers in the alimentary canal, and several are intimately connected with the process of digestion; their presence has also been discovered in the urine, showing that they must exist in the circulating fluids of the body, and when disease attacks the system their **reproduction** appears to be carried on with renewed energy. In their **destruction** the liver takes an active part, but the discoveries of Metschnikoff in relation to the **rôle** played by **phagocytes** has thrown a flood of light upon this much-vexed question.

Phagocytes, according to this distinguished author, differ but slightly from **leucocytes,** and it is claimed that their **function** is to destroy the bacteria which find their way into the circulation and permeate the tissues. These apparently useless corpuscles are **active agents** in preventing the ravages which would follow the general distribution of bacteria throughout the system, and show a most wonderful **capacity** for work. No delay occurs after these bacilli enter the tissues from the alimentary canal, or when introduced subcutaneously, until they are pounced upon by the phagocytes and eaten up, the products of this metamorphosis being carried off by the kidneys, the skin, the lungs, and bowels. When, perchance, the microbes are too numerous, or the phagocytes too few, the battle goes to the former, and, as a consequence the **invasion of disease** is more rapid and complete. We have taken occasion elsewhere to speak

of this **contest** in connection with the use of **quinine,** which has long been recognized as a specific for malarial cachexia, as follows: The assumption, whether well founded or not, is to the effect that quinine, when used in therapeutic doses, has the power to **prevent** the **migration** of the **white corpuscles** of the blood, influencing them to remain along the walls of the blood-vessels, while the remaining portion of the circulating medium flows through the centre. Under these conditions the white corpuscles act as **sentinels,** arresting the progress of the poisonous bacteria and destroying their vitality. If we accept this doctrine, there will be no difficulty in accounting for the great value of the remedy in the treatment of all malarial affections, since it may safely be assumed that these corpuscles have a **special affinity** for the germs of disease, while the large doses of the drug used are sufficient to produce the action we have already indicated. If further proof were needed, it is only necessary to mention the fact that the treatment of such diseases has become a matter of mathematical certainty since the adoption of the **hypodermatic** method of administration. It simply goes to show that the action of the remedy is more direct when injected into the circulation than when given by the mouth, and it may be assumed that coming in contact with the contents of the stomach or passing through the liver has something to do with its properties, destroying in part its efficiency.

But **few remedies** can be used in the liberal manner in which quinine is administered, the most active antiseptics being exceedingly irritant poisons. The most active of them, the **bichloride** of mercury, if given in sufficient quantity to be efficacious against the **microbe,** would prove fatal to the life of the patient, and we must, therefore, seek other measures which may be prevailed upon to act as allies to phagocytes. In the preceding pages the value and advantages of **purgatives** have been referred to, but the subject is mentioned here for the purpose of further emphasizing the importance of this adjunct in the treatment of disease. For the most part the bacilli reach the tissues through the walls of the alimentary canal, and whatever conduces to establish and maintain a healthy condition in the **digestive tube** will materially interfere with the reproduction of bacteria. An apt **illustration** of this observation is found in the use of **salol** in the treatment of **rheumatism,**—a remedy which possesses antiseptic properties, but which does not undergo **solution** until dissolved in the alkaline juices of the intestine. Its value has also been demonstrated in the treatment of **cholera.** Many of these microbes undoubtedly find their way to the **liver** through the portal circulation, and, knowing the destructive action of that organ upon alkaloids, it is but reasonable to suppose that its **function** is in direct **relation** with that of **phagocytes.**

There still remains **another topic** to be considered in connection with

antisepties, namely, that of **Ptomaines** and **Leucomaines** and the so-called **extractives,**—products which are ever at war with the healthy condition of the organism. They are of no less importance than that of bacteria, but the history of their development and the manifestation of their effects is still in its infancy. Brief reference will only be made to the subject here, but their influence should be considered in the management of every case of disease. **Cadaveric alkaloids** possess a medico-legal as well as therapeutic interest, and no physician can well afford to be without some practical data regarding their development. It will be sufficient to say that they are actively poisonous products found in the system while in a state of apparent health and after death. In **disease** their presence may obscure the real condition of the patient, and thus the treatment, based upon incorrect diagnosis, will be fruitless of good results. Cases have been recorded in which death was supposed to be due to some foreign substance introduced into the economy, and **chemical analysis** has shown the presence of some active poison so closely resembling an alkaloid that the accused have had great difficulty in proving their innocence. Under these circumstances it is needless to expatiate upon the need for accurate information relating to the development and the effects of the so-called cadaveric alkaloids, not only for the purpose of counteracting their action upon the system, but also for the bearing they have in a medico-legal aspect. A **single observation** here may be of interest, namely, when suspicion is aroused as to the real cause of illness in any case, and a fatal termination should result, the physician in charge owes it to his own reputation, as well as to that of those personally related to the patient, that every precaution should be taken to have a full and impartial investigation, and, as this cannot be accomplished satisfactorily if decomposition has set in, the body of the deceased must be exposed to cold to such an extent that no changes of this character can take place. There then arises no occasion for dispute, as the formation of cadaveric alkaloids and putrefactive changes will be promptly arrested.

In the foregoing sketch it will be noted that but little has been said of the respective drugs or remedies as to their power to prevent putrefactive changes, but the omission arises from the fact that it would be impossible to do justice to all, and the indications for the use of the different preparations will be found appropriately discussed in the body of the work.

The following **tabulated lists** have been prepared with the object of indicating in a general way the uses of the various remedies which have been advanced either as disinfectants or antiseptics. The **first** is intended to give a bird's-eye view of the **comparative action** of different preparations in the order of their importance, and is compiled from

Comparative Exhibit of the Power of Various Antiseptics.

(Experiments of de la Croix and confirmed by Koch.)

	Prevent the Development of Bacteria from Meat Infusion.	Prevent the Reproduction of Undeveloped Bacteria.	Kill Developed Bacteria.	Prevent the Reproduction of Developed Bacteria.	Prevent the Development of Spores in Boiled Meat Infusion.	Prevent Reproduction of Spores.	Prevent Development of Spores in Unboiled Meat Infusion.	Prevent Reproduction.
Corrosive sublimate	1: 25,250	1: 10,250	1: 5,805	1: 1,250	1: 10,250	1: 6,500	1: 7,168	1: 2,525
Chlorine	1: 30,208	1: 4,911	1: 22,768	1: 431	1: 28,881	1: 1,008	1: 15,606	1: 1,061
Chlorinated lime	1: 11,135	1: 488	1: 3,720	1: 170	1: 3,148	1: 199	1: 286	1: 153
Sulphurous acid	1: 5,448	1: 135	1: 2,009	1: 190	1: 8,515	1: 325	1: 12,649	1: 135
Bromine	1: 6,308	1: 769	1: 2,550	1: 336	1: 13,931	1: 493	1: 5,597	1: 875
Sulphuric acid	1: 5,734	1: 205	1: 2,020	1: 116	1: 5,734	1: 306	1: 3,353	1: 72
Iodine	1: 5,020	. . . . .	1: 1,548	1: 410	1: 10,020	1: 510	1: 2,010	5: 843
Aluminium acetate	1: 4,268	1: 59	1: 427	1: 64	1: 4,268	1: 937	1: 6,310	1: 478
Oil of mustard	1: 3,353	1: 220	1: 591	1: 28	1: 3,353	1: 77	1: 3,353	1: 40?
Benzoic acid	1: 2,867	1: 50	1: 410	1: 121	1: 2,877	1: 50	1: 1,439	1: 77
Borosalicylate of sodium	1: 2,860	1: 303	1: 72	1: 30	1: 1,343	1: 35	1: 2,860	1: 35
Picric acid	1: 2,005	1: 706	1: 1,001	1: 150	1: 2,005	1: 200	1: 2,005	1: 100
Thymol	1: 1,340	1: 109	1: 109	1: 20	1: 1,340	1: 109	1: 1,340	1: 20
Salicylic acid	1: 1,003	1: 343	1: 60	. . . . .	1: 3,003	1: 603	1: 1,121	1: 343
Permanganate of potassium	1: 1,001	1: 100	1: 150	1: 150	1: 2,005	1: 101	1: 300	1: 35
Carbolic acid	1: 669	1: 22	1: 22	1: 266	1: 402	1: 22	1: 502	. . . . .
Chloroform	1: 90	. . . . .	1: 112	. . . . .	. . . . .	. . . . .	1: 103	. . . . .
Borax	1: 62	. . . . .	1: 48	. . . . .	1: 30	. . . . .	1: 107	. . . . .
Alcohol	1: 21	1: 44	1: 44	. . . . .	1: 11	1: 177	1: 21	. . . . .
Eucalyptol	1: 14	. . . . .	1: 116	. . . . .	1: 20	. . . . .	1: 205	. . . . .
Chlorate of potassium	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .

information based upon the investigations of de la Croix, and in the main corresponds with the observations of Koch. The **second** includes the **disinfectants proper,** a class of preparations which have long been used to prevent the spread of contagious diseases. In the past much stress was placed upon the power of **deodorizers** for this purpose, but later experience has shown this class of preparations to be utterly worthless, and the sooner the public are educated upon this point the better it will be for humanity; they are a delusion and a snare.

It must be borne in mind, however, that the power of all these agents depends upon various factors, such as the concentration and character of the solution, the period of exposure and the temperature, and in estimating their influence variations of this kind must be taken into account. The **third list** embraces a considerable number of the most common antiseptics in use at the present time, arranged alphabetically:—

Disinfectants.

Bromine.	Chlorine.
Charcoal.	Iodine.
Chlorinated lime.	Iron sulphate (Proto-sulphate).
Chlorinated soda.	Potassium permanganate.

In addition to the foregoing, **other antiseptics** in common use may be mentioned as follows:—

Aniline.	Iodoform.	Saccharin.
Antipyrin.	Iron perchloride.	Salicin and Salicylates.
Arsenic.	Kairin.	Salol.
Benzoin.	Naphthol and Naphthalin.	Sulphites of alkalies.
Boric acid.	Oxygen and Peroxide of hydrogen.	Sulphides.
Chinoline.		Sulphocarbolates.
Copper sulphate.	Pyrodin (Hydracetin).	Turpentine.
Creasote.	Quinine.	Zinc chloride.
Hydroquinon.	Resorcin.	

ANTIPARASITICS.—These are remedies used locally to **destroy** the different **parasites** which infest the human body; they may also be used for a like purpose upon animals. Certain antiseptics, as **corrosive sublimate**, act as antiparasitics, but there is danger in its use, and in many instances other remedies have been found more efficient, as seen in the treatment of itch with **sulphur.** The action of these remedies is soon apparent, but inasmuch as germinating spores may not be reached, repetition is necessary at intervals until all traces have disappeared. As a rule, they are **applied** in the form of a lotion or an ointment; the ointments of the oleates are generally to be preferred, and in order to secure the best results ointments should be prepared with an animal fat. The following substances belong to this group:—

Balsam of Peru.	Mercury :—	Petroleum.
Carbolic acid.	Ammoniated mercury,	Storax.
Iodine.	Mercuric chloride,	Staphisagra.
Iodide of sulphur.	Mercuric nitrate,	Sulphur and
Mammea Americana.	Mercuric oxide.	Sulphites.
		Sulphurous acid.

THERAPEUTICS.

GENERAL CONSIDERATIONS.—The administration of medicines implies an acquaintance with some general principles involved in the treatment of disease. In the first place, the physician is expected to have at least a good general knowledge of **materia medica**, so that he is reasonably familiar with the characteristic features of substances usually prescribed in respect to the source from whence they are obtained, their general character and appearance, and the dose that is generally administered, together with the antagonists, both chemical and physiological. That matter has been considered in its proper place, and is referred to here only incidentally and for the purpose of bringing up the different parts of the therapeutic picture. The second subject demanding attention is that of **pharmacy**, that he may have an experimental knowledge of the operations and preparations which are placed in the charge of the pharmacist under his direction, and, if a true philosopher, he should not be unwilling to take his own medicine. The most successful doctors, as a rule, are those who give attention to these minor matters, and who make their patients feel that they occupy a relation to them which is rather more than nominal. Not that we would encourage any pretensions bordering on quackery, but it cannot be disputed that patients always do better when under the care of the physician of their choice, and it is but reasonable to suppose that this result is due in part to the interest they manifest for the welfare of the patient.

The third important qualification of the therapeutist is a comprehensive **knowledge of pharmacology**, either from the point of view which has just been indicated in the preceding pages, or from some equally desirable point of vantage, the object being to prepare the physician for the proper manipulation of the forces under his command. A general with an army of a hundred thousand men at his command is often at a loss from sheer inability to command his forces, while one with ability and judgment, with a tithe of the men, will be able to accomplish results only short of miracles. How often do we find in the medical arena those whose lack of success may properly be attributed to a superabundance of knowledge, and who, like the general with the immense throng at his command, find that their knowledge is not practical, and, besides, it is unwieldy. Alas! too often do we find that our so-called evidences of

medical lore are characterized by more learning than judgment. It is to be hoped that a study of the methods we have seen fit to adopt will be followed by results in keeping with the amount of labor expended in the effort to acquire practical information upon this important topic. The whole purpose of the present age appears to be directed to that channel which shall promise the utmost on the score of **practical utility,** and with this commendable object in view our work has been actively prosecuted, but as no scientific relations can be established in medical practice unless through pharmacology the duty was plain; the spirit of the times is progressive; the men of the times are on the outlook for practical ideas, and with a view to meet this demand in the line of therapeutical inquiry the following pages have been prepared.

MODES OF ADMINISTRATION.—The effect upon the system varies according to the method by which the drug reaches the circulation; also from the form and time of administration, and especially is this true in respect to the dose given and its frequency. These different topics may be conveniently discussed under two heads, the former under the title we have selected, and the latter under the head of **Absorption** and **Elimination.**

Medicines enter the system by the following routes:—

By the **Skin or Mucous Membranes,** by means of **external** application of liniments and ointments, and by painting, as in the use of iodine and cocaine, and by plasters, as in the case of cantharides; by fumigation, as in the use of calomel in the mercurial bath; **locally** to mucous membranes, by the use of gargles, injections, either as a wash or spray, or by insufflation, or by simply dusting over the surface, as in the application of calomel to the conjunctiva. While all these measures have for their object the relief of **topical complications,** such as pain, inflammation, cutaneous disorders, or injuries, their effect is manifested by improvement of the general system, which has suffered derangement from local causes acting through the nervous system.

The methods of **local medication** will vary according to the demands of the economy, as viewed from the stand-point of the physician. The **enepidermic** method is confined to the simple application of the drug to the skin; the **epidermic** method differs from the former simply in the use of friction, while the **endermic** method consists in the application of the remedy after removal of the cuticle, by which absorption is greatly facilitated. Still another topical method, **inoculation,** should be mentioned, as illustrated in the prophylactic treatment for small-pox.

The use of medicines by **friction or inunction** is still a plan which commends itself to a limited number of practitioners. For many years, the local use of **aconite** in the form of liniment, for rheumatic affections, was

in great repute, but that has been superseded by more efficient measures. **Soap liniment,** with massage, is frequently of great value in overcoming stiffness after injuries, and Aulde has published a series of cases* covering the successful application of **salicylic acid** paste in the treatment of chronic joint affections. The most popular, as well probably as the most efficient, remedy to take the place of such methods has lately been found in **antipyrin;** the action of the remedy is prompt, and where there is no heart complication the use of external applications of this character can be avoided. As a further substitute for applications of this character, especially when dependent upon a rheumatic diathesis, we should note rhus toxicodendron (*q. v.*).

For the most part, however, the administration of medicinal substances is **confined to the mouth,** by which the alimentary canal is reached, with a view to affect the **nutrition,** as in the exhibition of tonics, acids, astringents, refrigerants, and alteratives; or the object may be to influence the economy through the **nervous system,** by acting upon the brain and spinal cord, the central nervous and ganglionic system, the heart and circulatory system, or certain special organs or tissues.

In a general way it may be remarked that all therapeutic indications are based upon our knowledge of the action of remedies when administered per *via naturales*, and in the discussion of pharmacological data we have kept that principle prominently in the foreground, not so much by associating with it special diseases, as by hinting at the various diseased conditions which pharmacology indicates may be met by the drug under consideration. Without absolutely following a set method of classification, which is liable to become tedious and uninteresting,—in short, perfunctory,—the aim has been to so conduct the consideration of these topics that our observations shall have a direct bearing in the selection of suitable remedies for the relief of suffering and the removal of disease.

The improvisation of the **rectum** as a media for alimentation and medication is of comparatively recent origin, but the successful application of the method for the past decade furnishes the best evidences of its utility. In females the vagina may be adapted for this purpose to a limited extent, chiefly for the relief of local disorders, and when constitutional treatment would be inefficient or useless.

The use of drugs by the rectum or **gaseous enemata** will include those cases of disease attended by irritability of the stomach, or intolerance, and cases of exhaustion from wasting disease. Again, the local effect may be desired, as in the case of pelvic, cystic, or rectal affections, and for the destruction of worms, or for the purpose of unloading an

* Medical Bulletin, vol. ix, p. 198, 1887.

impacted colon. The subject is referred to more in detail under the head of Alimentation (Rectal Alimentation and Medication).

Attention should be directed here to the absorbent power of the **bladder,** a subject which has lately been investigated by Tricomi, of Rome. According to this observer we have in the healthy bladder a means of reaching the circulation with the same rapidity as when medication is conducted hypodermatically, at least in the use of strychnine sulphate, prussic acid, and sulphuretted hydrogen. Other drugs which were tried were less active, and in rabbits it was found that five times as much cocaine was required as when introduced by the needle. The **antiseptic** power of the mucous membrane of this viscus should be noted, as Tricomi found that the injection of putrid liquids produced no constitutional effect, although when the epithelium is abraded the introduction of micro-organisms is quickly followed by signs of intoxication; it was also noted that when suppurative processes were in progress the absorption of bacilli was rapid. These investigations may be of value to us in the matter of treatment when we wish to prevent the absorption of micro-organisms from a diseased bladder, and should be the means of assisting nature in overcoming the effects of morbid conditions.

HYPODERMATIC MEDICATION consists in the introduction of the selected medicament by means of an appropriate instrument under the skin, by which it is deposited either in the cellular tissue (**subcutaneous**), or into the more deeply-seated tissues or organs (**interstitial**). The efficiency of this method has long been recognized, and its application is gradually extending until at present it includes the treatment of various classes of diseases in addition to its use in emergency cases, for which it was originally suggested. So general is this practice that a special article has been devoted to the subject. (See Hypodermatic Medication.)

INTRAVENOUS INJECTION is simply a modification of the hypodermatic method, consisting in the introduction of stimulants or saline solutions into the superficial veins in cases of collapse from heart disease, from shock, or from hæmorrhage, by which the substance deposited within the vascular system is enabled more quickly to reach the heart and central nervous system. It is substantially an impromptu method of performing transfusion, but, generally speaking, this method of medication is confined principally to the experimental investigations of the laboratory.

MEDICATION BY INHALATION of late years has attained wide popularity, the announcement by Bergeon of the successful application of gaseous enemata for the relief of pulmonary affections contributing largely toward investigations in this direction. Another factor which has given an impetus to experimental or tentative efforts for the purpose

of prolonging human life is probably to be found in the extravagant claims advanced by quacks concerning the wonderful results attending the **inhalation of oxygen,** or other compounds intended to replace it. Literature upon this subject is incomplete as to methods and results, but the indications are sufficient to warrant a study of the matter in its present condition, which may be regarded as the transition stage.

There yet remains to be added a word concerning the methods of **inhalation** as practiced by physicians giving special attention to **throat and chest affections,** which include medicated inhalations, either in the form of spray, by the use of an atomizer, by exposure to the fumes of volatile substances, or by contact with vapors of natural medicated waters, as conducted at various springs in this country and abroad. The whole aspect of the subject will be found discussed under Medicated Inhalations.

ABSORPTION AND ELIMINATION.—In considering the effect which medicines are calculated to produce upon the system, it is important that an estimate should be made of the complications that may arise by reason of the drug not being properly absorbed, or when taken up by the tissues, its prompt elimination being interfered with, a **cumulative action** may be the result. Investigations with **curare** have shown that, when introduced into the system by intravenous injection, it was rapidly eliminated by the kidneys, but when the renal arteries were tied, and elimination prevented, death followed from the use of the same quantity of the drug that before had caused but the slightest systemic disturbance. When **strychnine** is introduced into the bladder, the effect becomes apparent as quickly as if the same had been used hypodermatically, and the same drug, when introduced into the healthy pleural cavity, will be promptly followed by the characteristic physiological effects.

Cumulative action is illustrated in the foregoing reference to curare, and is simply the action of the drug which has accumulated in the system; if the drug be given in such doses that **elimination** is not sufficient for its removal from the system, then the same effect would follow. It will be noted that this differs materially from the so-called cumulative action of **digitalis,** which has the effect of paralyzing the heart when long continued, even with the exhibition of small doses. Digitalis does not interfere with the action of the kidney, but, on the contrary, it increases the renal secretion; but patients have succumbed under the use of digitalis, and it has been understood with the medical profession that death was due to the cumulative action of the drug.

Absorption is **generally** by the **stomach,** and from the stomach the stream of blood carries it to the liver, when that which remains of the drug passes into the general circulation. Some drugs, however, are not

dissolved in the acid juices of the stomach, and they are carried on to the small intestine, where solution is effected, and from thence the drug is carried to the **liver** as in the case of absorption from the stomach. This, of course, does not apply to the action of poison like hydrocyanic acid or corrosive substances, which often kill almost instantaneously, but to the general method by which absorption is effected when drugs are taken into the stomach. There are quite a number of remedies which may be expected to gain entrance to the general circulation **more rapidly** when taken up by the glands of the mouth than when allowed to enter the stomach, and this practical fact can be taken advantage of when giving various remedies. If, for instance, we are anxious to get a patient quickly under the influence of **aconite,** belladonna, or pilocarpus, it will only be necessary to have the medicament in the form of a readily soluble tablet triturate, and ask the patient that it may be allowed to dissolve in the mouth. So small a dose as one-tenth of a minim of aconite tincture administered in this manner at intervals of five or ten minutes in attacks of rapidly developing **tonsillitis** may be depended upon to exert a decidedly favorable action upon its progress, and with other suitable medication, if called in time, no cases need go on to suppuration. **Atropine** given in a similar manner in the case of **hoarseness,** in simple pharyngitis, with congestion of the mucous membranes and possibly loss of voice, will frequently produce effects which are truly wonderful.

The condition of the **stomach** will modify the activity of absorption. When there is a condition present which embraces those features known as **biliousness,** accompanied by a coated tongue and foul breath, the processes of assimilation are seriously embarrassed. Such is frequently seen in the early stages of many diseases, and, of course, the first indication will be to remove this obstacle to treatment. If there are symptoms of organic disease of the stomach, the **physiological remedies** should be given with extreme caution, or it will be found that cadaveric alkaloids have found their way into the system, and we shall have to deal with a factitious as well as a real disease. Doubtless the **impure pepsins** which are to be found in the market are responsible for many cases of severe illness, which without their use would be comparatively trifling.

The **form** of the **medicine** should always be adapted to the condition of the stomach, and in writing a prescription it will be necessary for the physician to exercise care in selecting the preparation. At one time a drug in the form of **powder** may be that which is best suited to the demands of the patient; at another it may be necessary to give it in the form of a **liquid,** so that absorption may be hastened; again, there are instances in which the drug should be given in the form of a **pill** or a **triturate.** This latter observation applies especially to the administra-

tion of **ipecacuanha**; if taken in pill form with a view to affect the liver, and indirectly the skin, the renal system and the respiratory apparatus, as much may be given at one dose as would be required for an entire week if exhibited in the liquid form. But the **small doses** would have no apparent effect such as is desired, and therefore the time would be wasted, and the health of the patient jeopardized.

In deciding upon medicines for **children**, the form is of the greatest importance, as it frequently happens that a **dislike** is occasioned for the doctor owing to the **nauseating** character of the **medicine** ordered, which lasts during the life of the child, and we regret to say that parents are not loth to foster such a disposition—probably because they have been sufferers themselves. Every effort should be made to secure the approval of the patient's **palate** by making combinations which shall not prove nauseating, and yet be efficient.

The **time** at which medicines are exhibited is an important element. If taken **fasting** in the early morning, the action may be very much greater than when taken under less favorable conditions for its absorption. There are, however, some medicines which are supposed to be far **more efficacious** when taken under these conditions. **Quinine**, in malarial affections, and decoction of **pomegranate**, for tape-worm, should preferably be given in the early morning, when the stomach is empty, but caution is required in order to prevent the rejection of the preparation by **vomiting.** The **season** of the year and the **climate** also have an influence upon the effect of the medicine on the system, but in temperate climates this is not a factor of sufficient importance to demand attention, except at times of unusual **heat** or excessive **cold.** Extremes of weather always have a depressing influence upon the system, but this is not especially noticeable until toward the close of exceptional periods. It is most marked after continued wet weather, accompanied by cold and high winds, and those who have given the matter attention seem to think that the **sickness** is generally more **widespread** at the close of a long and cold winter and toward the end of an unusually hot and dry summer. As a rule, those who suffer most from such extremes are the **children** and the **older persons** in a community, and in cases of this character the physician should consider the best means of maintaining a healthy condition of the nutrition, adding such stimulants as may be indicated by the depreciated condition of the nervous system.

The **manner** of exhibiting the drug or drugs will depend, to some extent, upon the immediate needs of the patient. To relieve **urgent symptoms** a hypodermatic injection may be required, or a case of active congestion threatening brain complications will demand venesection. Emergency cases are often due to a disordered condition of the stomach,

and the first thing to be insisted upon will be the unloading of the stomach by an **emetic**; and in a case of **poisoning,** when there is a possibility that any of the substance still remains in the stomach, an emetic should not be omitted. **Combinations** will involve both chemical and physiological considerations, which will be referred to under the head of Incompatibility; but the suggestion is put forward that if the physician does not know the effect which will be produced by the combination ordered, it will be far better to confine himself to the **single remedy.** There are times, however, when a combination of drugs which do not have the same general action upon the system may be united with the best results, but it is needless to say that such combinations should be ordered with care and their effects faithfully watched.

The general **habits** of the patient should be taken into consideration. Persons who are daily engaged in hard labor will not be influenced to the same extent by drugs as those who live luxurious lives, or who may be engaged in sedentary employment; but there is not so much difference here, aside from idiosyncrasies, as one would at first suppose. It will be found that when the dose is properly apportioned there is but little danger of meeting with any untoward action, except in the case of drugs which are somewhat uncertain in their action, and then the fault is rather with the drug than with the patient. But we cannot overlook the fact that the **age** and **sex** of the patient should be considered, and the **temperament,** as well as any **diathesis** which may be present. Lack of attention to these details will occasionally end disastrously to the physician by his losing the confidence of his patient. **Diet** is a matter which cannot well be overlooked, and, while that has much to do with our methods of medication, it frequently has far more to do with the welfare of the patient, and attention to it will be an important factor in hastening his recovery.

It seems scarcely necessary to mention that the **character** of the **disease** will have an important bearing in the selection of the drugs, not only with reference to their absorption and elimination, but with reference to the form, time, and manner of prescribing. The **symptoms** of the patient, both subjective and objective, should not escape the attention of the physician, and without a daily record of **temperature** his hands are practically tied.

Idiosyncrasy is one of the most difficult things to meet in estimating the effects of medicine, but it is not too much to assume that many cases of so-called idiosyncrasy are but instances of **cumulative action,** in which there is a failure to eliminate the drug from the system. But all cases of this class are not so simple, as it not infrequently happens that the first dose of quinine will develop a scarlatinous rash, or a small dose of belladonna cause exceptional cerebral symptoms. Occasionally the un-

desirable effects of a drug may be overcome by administering at the same time some other preparation which will, in a measure, counteract its objectionable features. Thus, the **bromides** are used to overcome the objections to the administration of large doses of **quinine,** and it has been found that the sensitiveness of the nerves may be obtunded and still the action of the quinine will be apparent, just the same as if nothing had been used to diminish the subjective symptoms which it produces. Some persons are able to take certain preparations of a drug, but not others, and, when there is a special indication for the remedy, the **form** of the medicine can be **changed.** Others are susceptible to **large doses** of certain medicaments to such an extent that they are practically barred, but in these instances the physician may find that a smaller dose not only will be well borne, but will be quite as efficacious as the larger one. This condition may be reversed : the patient may be unable to take a **small dose** without discomfort, but a large dose of the same drug will be not only well borne, but will be found to have the desired effect. The use of **quinine** furnishes an illustration of the first, while the use of **iodide** of **potassium** illustrates the second. A single grain of quinine may be distributed over the day, and continued in this manner often with the happiest results, but ten grains of the same drug, taken at one time or during the day, would cause most distressing symptoms. Five grains of potassium iodide may in some persons cause the appearance of the characteristic eruption and other unpleasant symptoms, but if the dose be increased to thirty grains three times daily there will be no difficulty whatever, and this even in the absence of a specific history. A report published by Knapp,* of Boston, emphasizes this observation, and goes to show that **small doses** are sometimes more liable to produce **iodism** than large ones, and what is true of this drug is also true of **mercury,** small doses being far more likely to produce ptyalism than large ones. This, however, can be avoided by decreasing instead of increasing the dose of mercury, just as we have indicated in the case of the administration of quinine.

The discussion of idiosyncrasy has brought us into consideration of the **tolerance** of the human system **for drugs,** but, as that is a matter wholly in the hands of experimental physiologists, it demands but slight consideration at our hands. We do not undertake to give any of our drugs in such proportion to the weight of the patient as is the custom in the laboratory, although the physician is interested in knowing from time to time the weight of his patient, so that he may calculate upon the good results which attend upon his treatment. An attempt has been made to estimate the amount of corrosive sublimate which would be

* Therapeutic Gazette, June, 1889.

required to saturate the tissues to an extent that would affect the microbes, but it was found that the ordinary dose would have to be increased so many thousand times that the scheme was abandoned as wholly impracticable.

The tolerance of the system for drugs is only equalled by the persistent **resistance** shown by it **against disease.** It is evident, therefore, that neither idiosyncrasy nor tolerance depends altogether upon absorption; at least, so far as our present investigations indicate.

Dosage.—In the administration of medicines one subject, the **size of the dose,** has always been a vexed question, and, judging from recent literature, there does not appear to be any more likelihood of approaching agreement than there was twenty years ago. Whenever the question comes up for discussion, we are referred to the observations of experimental physiologists, where they have made the most careful calculations with respect to the effects observed when the proportion of the drug bore a certain relation to the weight of the animal; but, as that has already been referred to, space need not be taken with a discussion of the matter at this time, further than to say that this method cannot be adopted in the treatment of disease. The **period** at which the medicine is **exhibited** in the usual medicinal doses will have a greater bearing upon the effect produced. This fact may be **illustrated** in the plan adopted by certain practitioners in the exhibition of **pepsin.** Should this physiological remedy be given in combination with an alkali, its activity will be **neutralized,** and Winslow has shown by very careful observations that the same result may be expected when the drug is given in combination with many other remedies which are supposed to be synergistic in their action to pepsin. Regarding the use of **pancreatin,** Chittenden has demonstrated by laboratory experiments that it is practically impossible to use that remedy with any hope of effecting improvement in cases of indigestion, because its activity is destroyed in the acid juices of the stomach. Now, what shall we conclude when the physicians who give pepsin with an alkali claim that they are warranted by the good effects which follow its administration? What answer shall we make to those gentlemen who are regularly accustomed to prescribe pancreatin for indigestion, and who assert most positively that the best results attend its use, the statements of experimental physiologists to the contrary, notwithstanding? The **solution** of the complicated problem may be found in the matter of the **time** of administration rather than in the size of the dose.

In the preceding pages we have taken occasion to speak of the action of drugs when given in **small doses,** and it will be appropriate to mention that there may possibly be something more in it than what has been

variously called the **selective** action, or action by **substitution.** The subject will be better understood by assuming that the effects observed from the exhibition of medicines are in the nature of a **resultant** action; that is, the disease action and the drug action combined produce an effect upon the economy which is erroneously spoken of as the drug action. That this assumption is warranted will be apparent when we take into consideration that many drugs which produce marked effects during **disease** do not produce any appreciable effect in **health. Quinine** in large doses in health does not appreciably lower the **temperature,** and the same is practically true of some of the more powerful antipyretics. In answer to this it will be said that the **interaction** of the various functions will sufficiently account for this **apparent paradox,** and as an illustration we are confronted with the statement that sometimes **digitalis** fails to reduce the pulse during an attack of pneumonia; and while this theory of interaction of the functions will explain the failure of digitalis in this particular instance, it does not cover the use of the other drugs which have been mentioned. It cannot be made to do duty of this kind, simply because in the one case we have a condition of health to deal with, while in the other we are dealing with a diseased condition. The cases are **not** by any means **parallel.**

The size of the **dose** is not always an **arbitrary** matter, and depends upon so many unknown factors that it must be largely a question of **experience.** A practical **demonstration** of this is found in the experience of Fenton, of Streator, Illinois, in his observations of the effects produced by the exhibition of **rhus toxicodendron** for the relief of a case presenting all the indications of sciatica. The patient had been under the treatment of several physicians for a number of weeks before coming under his care, but all the usual remedies had absolutely failed, when he was advised to seek further treatment under hospital management; but ten days effected no change or improvement whatever. At that time the patient again came under observation, and was placed under the influence of the tincture of rhus, one-half drop in water three times daily, with the result that perfect recovery followed after the first five doses of the drug had been taken. Aulde has reported a number of cases in which cholera morbus and allied affections were promptly and permanently relieved by the exhibition of arsenite of copper in doses of one one-hundredth of a grain, distributed over a period of one or more hours; but these subjects will be referred to more fully under their proper headings (*q. v.*).

The dose must also be considered with reference to the so-called **primary** and **secondary** action of the drug. For example, we may refer to the primary and secondary action or effect of **alcohol,** and as this

brings us to consider the **remote** and **local** effects. both may be considered in the same paragraph. Alcohol produces a local effect upon the mucous membrane of the stomach with which we are all familiar, at least theoretically, but in addition there is a remote effect which is manifested upon the liver and upon the tissues of the kidney. Then, again, there is the effect which is produced through the interaction of the various functions, which may be called the secondary effect. Aside from the first effect of alcohol taken into the stomach, which is in the nature of stimulation, there is the secondary effect manifested by inco-ordination of movements, and with this effect comes depression. The remote effects of alcohol will be found in the liver and in the kidneys.

Bismuth is a sedative to the stomach, and such is the local action when first given, but when large doses are long continued, the subnitrate being a crystalline substance, it causes irritation, and thus we have the secondary effect. **Chlorate of potassium** is a drug which produces secondary effects by acting as a **protoplasmic poison** at the points of elimination, and, when given in considerable doses and long continued, the kidneys suffer from this remote action, which is substantially the secondary action of the drug.

As a rule, then, the **dose** of the remedy should be **small**, and, as the **duration** of the action will depend to a considerable extent upon the size of the dose in all acute cases of disease, the frequency of **repetition** will keep the system constantly under its influence. Not infrequently, when the dose is large **absorption** is **arrested**, and, besides, it is not impossible to assume that, even when absorbed promptly, the effect of the quantity may be sufficient to interfere with elimination. When small doses are given, these complications cannot well arise. A single dose of five drops of the tincture of **aconite** may be sufficient to produce constitutional effects, but it may be less efficient in preventing the spread of inflammation than the same amount distributed over a period of several hours, so that the dose shall not exceed half a drop. **Gelsemium** is a drug which will afford an excellent illustration of the value of small doses; a single drop at intervals of half an hour or an hour will be found an efficient remedy for the relief of acute attacks of fever in connection with high motor excitement, but ten drops at once will be liable to cause **ptosis**, diplopia, and other physiological symptoms which may require restoratives that shall neutralize practically all the good which might have been expected from the large dose. **Ergot** may be given with great benefit in doses of one drop of the fluid extract at short intervals in many instances, but there will arise occasions when it is necessary to give as much as an ounce at a single dose, in which cases of course, we have to take the chances of absorption and elimination.

In the body of the work the **dose** has been **regulated** in accordance with the usual **custom** of the time, except in the case of some drugs which it is believed may be followed by untoward effects, in which instances the size of the dose has been reduced, or some observation has been made concerning the precautions necessary in its administration.

INCOMPATIBILITY.—The first attempt of the **recent graduate** in medicine to write a prescription is generally attended with **complications** which are extremely **embarrassing**, but this is particularly true in regard to the combination of medicine which he decides to order for his patient. To him the matter of incompatibility is one which discloses unlooked-for difficulties, because he has in mind such a large number of remedies that would be suitable for the disease, were it not that their combination might result in such a way that none of the ingredients would be of value. **Older physicians** do not experience this hesitancy, owing to the fact that they have learned to confine their therapeutical resources within certain prescribed lines, and, besides, they not only do not object to incompatibles with which they have become familiar, but they often order those preparations which are known to be incompatible. It should be noted, however, that this latter method must be conducted within certain circumscribed limits, as the general use of incompatibles cannot be expected to result beneficially to the patient.

A brief study of the subject will be sufficient to direct the methods of the student and enable him to avoid those quagmires into which it is believed many of the older practitioners have fallen. There are **three general divisions** embraced in this category, as follow:—

CHEMICAL incompatibility results from the antagonism which one ingredient shows toward another when the two are combined in the form of a solid, powder, or liquid, but it does not signify that these compounds are inert from a medicinal stand-point. In fact, the chemical combination thus secured may be just the preparation which is wanted by the physician. By the combination of iodide of potassium with corrosive sublimate chemical action takes place and a new compound is formed, but it is a preparation the value of which has been demonstrated, and hence there can be no objection to it other than that relating to the cosmetic effects; **inelegant** preparations are to be avoided as far as possible. We are thus reminded that the physician must be possessed of at least a modicum of chemical lore as well as a knowledge of pharmacology. The practical application of this information will be shown in the combinations which are ordered for patients, and will prevent the intelligent physician from ordering drugs in combination which destroy each other's usefulness. For example, he should avoid the exhibition of substances containing tannic and gallic acids in combination with preparations con-

taining tincture of the chloride of iron, because the result will be in the shape of an inky mixture; the use of albumin and alkaloids generally in this combination is open to the same objection. Glucosides are destroyed by the action of free acids, and the salts of the alkalies are destroyed by caustic alkalies; and alkalies and alkaline salts have the effect of precipitating alkaloids and their salts. This latter observation will be apparent from the note that has already been made regarding alkaloids, viz., that they are found in plants in combination with an acid.

PHARMACEUTICAL incompatibility is the name given to that form of disagreement between two substances which prevents them from combining with each other to form a clear solution. An **illustration** of this may be seen when attempting to add water to a fluid extract which contains a resinous property or ingredient. Quite a number of the fluid extracts possess properties of this kind, and when it is desired to add water to them and still preserve the resinous part in solution, it will be necessary to introduce into the mixture a portion of powdered acacia. In these cases, where the use of alcohol is not contra-indicated the simple elixir may be used instead of preparing the product in the form of an emulsion.

When administering quinine in an acid mixture with licorice it will be found that the mixture presents an unsightly appearance because the acid has precipitated the glycyrrhizin of the licorice, thus defeating the purpose for which the licorice was used, namely, that of disguising the taste of the quinine.

PHYSIOLOGICAL incompatibility is a matter of no less interest to the physician than that which refers to chemical and pharmaceutical disagreement. The matter will probably be better understood by referring to **poisons** and their **antidotes** on preceding pages, in which it was explained that after the ingestion of a poison its physiological antagonist might be administered with the expectation that the effects of the first poison might be counteracted by the second, until such time had elapsed as was required for its elimination from the system. **Chloral hydrate** is the physiological antagonist of **strychnine**, and in the case of the ingestion of a lethal dose of one, the other may be used in doses sufficient to counteract the effects upon the system until it has been eliminated through the proper channels. A **note** should be made of the fact that if a lethal dose of both poisons is taken at one time the effect will be fatal, but not so when one is taken and the other allowed to follow within a reasonable time.

Sometimes we take **advantage** of this physiological **incompatibility** by exhibiting two medicines whose effects are diametrically opposed to each other, and the two drugs just named may be used for this very purpose.

When it is desired to obtain the hypnotic effect of chloral, and this drug is contra-indicated by the condition of the heart, it may be taken, and within a short time afterward the physiological antagonist, strychnine, may be administered without danger to the patient from the depressing action of the chloral. **Morphine** and **atropine** are well-known physiological antagonists, but the value of their joint use hypodermatically has been demonstrated, and is now in accordance with established usage. In this instance we have an illustration of the narcotic action of the two drugs when given in combination.

A **general rule** has been laid down by teachers that no drug should be given in combinations with either its tests or antidotes, but we have just seen that an important exception to the rule is a method now in general use, and the suggestion is advanced that while the rule may be a good one, it has, like all others, its exceptions, which do not invalidate, but rather go to strengthen it. Whenever it has been found by experience that physiological incompatibility does not destroy the therapeutical value of a compound, and there is no danger of chemical or other changes so modifying it that the use may become unsafe, there is a general consensus of opinion that such incompatibility may be overlooked. In the following pages a number of formulæ will be found presenting this characteristic, and, although the practice cannot be approved from a scientific point of view, we cannot deny the value of what may be termed empirical methods of practice.

A limited number of drugs may be named which do not combine readily, and for this reason are better given in simple solution, or where available in the form of tablet triturate :—

Chlorine in solution.
Guaiacum tincture.
Iodine and its liquid preparations.
Iron and Quinine citrate.
Lead salts.
Mercuric chloride.
Permanganate of potassium.
Potassium iodide.
Silver salts.
Sulphuric acid.
Tannic and Gallic acids.
Zinc salts.

THE PRESCRIPTION.—The efficient and palatable preparations now within the reach of physicians have greatly lessened the needs for care and calculation on their part in combining the various remedies which they may wish to use. Notwithstanding the **advances** which have been made in chemistry, in pharmacy, and the additional light which has been thrown upon the science of medicine by physiological investigations and by pathology, the **modern objections** urged against a combination of medicines as embraced in the general plan of writing prescriptions do not stand; and the general principles included in the method still challenge the admiration of all regular physicians, whether they use the single remedy

or a combination which shall offer itself as a model of **polypharmacy.** The object of treatment is to cure disease, and the **principles** embraced in the prescription are **illustrated** in the well-known maxim, "*cito*, *tute*, *et jucunde.*" To cure our patients quickly, safely, and pleasantly should be our aim, and to accomplish this desirable object much depends upon the contents of the prescription. The **simplicity, beauty,** and **efficiency** of prescription-writing can be estimated by the careful observer from the character and quantity and the number of medicaments ordered, when considered in their relation to the disease and the end to be secured. The **story** is related of a French pharmacist that he one day refused to put up a physician's prescription containing a large dose of chlorate of potassium because he had learned incidentally that in previous cases the children who took that medicine always died, and he felt that he was not warranted in becoming partly responsible for the blunder of the physician.

Before taking up the matter of **prescription-writing** proper, it may be worth while to say a few words regarding the **combination,** to which we have only briefly referred. In connection with the remarks relating to **incompatibility,** on the preceding pages, the subject of combinations will be appropriate.

In the **first** place, in making combinations, incompatibles should be avoided, unless there is some reason for making an antagonistic preparation, as described on the foregoing pages. In the **second** place, the idiosyncrasy of the patient must be taken into consideration, and, if the combination is such that unusual effects may be produced calculated to alarm the patient or his friends, the dose should be properly adjusted, and the nurse given instructions as to the manifestations to be looked for and the appropriate treatment in case of emergency. In the case of **acute attacks** it may be necessary to give certain information as to the length of time which one drug or combination should be continued, and it will be needful that the patient or the nurse should understand and be able to appreciate the conditions indicating that it should no longer be given after the object sought for has been attained. True, this matter trenches upon the practice of medicine, but it is not out of place in this connection.

The **reaction** which has set in **against combinations** has had the effect of driving many to the opposite extreme, and has, to a certain extent, created a species of **nihilism** in the ranks, but such variations can have no material effect upon the onward march of science. Certain combinations in use a generation ago are quite as valuable in selected cases as they were at that time. An **example** of this is to be found in the idea of getting the virtues of cinchona from a combination of different preparations, which shall include the fluid extract, the tincture, a decoction, and an

infusion. The same results are claimed from a combination of the different solid or alkaloidal preparations. **Another idea** which is worthy of notice is to be found in the combination of various drugs having the same general action, such, for instance, as gentian, calumba, and nux vomica, and to this you may add capsicum and rhubarb, if you like. The **story** is related of a druggist, who called upon a celebrated physician, paid him a handsome fee, and who found, to his chagrin, that the prescription contained but a few of the most simple preparations of this class, which he was accustomed to dispense daily over his own counter; but, as an experiment, he had it put up, and was greatly surprised to find that it cured his disease. This practical knowledge of pharmacology is beneficial in the **making** up of **pills,** certain ingredients being added which are supposed to have a selective action upon the different portions of the alimentary tract. A similar principle is involved in the use of **cholagogues** in connection with **salines,** with a view to obtain better results from the cholagogue. The administration of **calomel** in connection with the alternate exhibition of **magnesia sulphate** will be found a most efficient diuretic. Under the head of Stomachics, the combination of tonics with stimulants and sedatives has been mentioned. In the treatment of **uterine affections,** a combination of drugs known to possess certain properties which are of value in relieving functional disorders will be found of more benefit than a single remedy. As an **example** of this, a prescription containing ergot, cimicifuga, and hamamelis may be mentioned. In prescribing **hypnotics,** the addition of an anodyne or narcotic will be attended with the best results, because only a small quantity of each will be required; and in the use of drugs known to have a depressing effect upon the economy which would be undesirable, the judicious administration of remedies to counteract this depression should not be overlooked.

The **model prescription** requires for its production not only the skill of the pharmacist and a knowledge of the science of pharmacology, but the prescriber must be informed regarding pathology, as without such information he is liable to err in directing their preparation and in the selection of his drugs. The **classical form** embraces the following four parts or subdivisions, a brief description of each being appended herewith :—

1. **The Superscription.**
2. **The Inscription.**
3. **The Subscription.**
4. **The Signature.**

The **superscription,** in addition to the letter ℞, originally used as an appeal to the planet Jupiter, should also contain the name and address of the patient, with a view to prevent mistakes on the part of the phar-

macist or the friends of the patient. By common consent, the **symbol** ℞ is now taken as the imperative of the Latin verb *recipio*, "to take," and its literal meaning is, therefore, "take thou," or "take."

The **inscription** covers the body of the prescription proper, and, as a rule, is written in Latin, although there is no good reason for so doing except that the **Latin** is an universal language, and abbreviations in that can be deciphered in all countries, when such abbreviations in other languages might result in error by reason of the pharmacist not understanding the object of the prescriber. With the object of facilitating prescription-writing, and enabling the student to familiarize himself with many of the abbreviations and terms used, a somewhat extended list has been prepared, and will be found on the following pages, and it is strongly commended to the attention of students and recent graduates. For the purpose of further elucidating this matter, a considerable number of approved formulæ have been inserted in the text throughout the work, and it is believed that with these as illustrations it will be unnecessary to take up space and time with a full *résumé* of the subject.

The **subscription** is intended solely for the dispenser of drugs, and for the reason given above it is generally written in the Latin language. With this, and with the ingredients ordered by the physician, it is assumed the person for whom the medicine is intended has no business,—that it belongs wholly to the prescriber,—and, as it is often advisable to conceal from the patient the real character of the medicine ordered, this again furnishes another reason for writing the whole in some language with which the patient is unacquainted.

The **signature** is that part of the prescription devoted exclusively to the patient, and may either be in Latin, which must be translated by the pharmacist, or it may be, and is generally, written plainly in English, or in that language which the patient best understands. The signature does not include the **name** of the **prescriber,** which appears at the bottom of the usual blank, either the full name or the initials.

The **date** of the prescription should never be omitted. It may be placed at the top, although those who have not already formed a habit in regard to this will find that it can most conveniently be added at the left-hand lower corner after the name or initials have been attached. One **advantage** which this plan possesses is that, after the mental exertion of preparing a prescription, this mechanical operation of adding the date affords a momentary relief, when the prescriber is ready to scan the written prescription with a view to discover any errors which may have crept into it, and every calculation as to the dose and the proportions of the different medicaments should be carefully gone over before placing the order in the hands of the patient.

The inscription is **apportioned** in the following manner:—

First. The basis, or principal ingredient.

Second. The adjuvant, or auxiliary, to assist its action.

Third. The corrective,—some substance used to correct or diminish an undesirable quality.

Fourth. The vehicle, or excipient, to give it a suitable form for administration.

Latin Words, Phrases, etc., Used in Writing Prescriptions; with their Contractions and Corresponding English Equivalents.

WORD OR PHRASE.	AS GENERALLY WRITTEN.	ENGLISH EQUIVALENT.
Ad (with accus. case)	Ad	To *or* up to.
Ad duas vices	Ad 2 vic.	At twice taking.
Ad libitum	Ad lib.	At pleasure.
Ad tertiam vicem	Ad 3tiam vic.	For three times.
Adde	Add.	Add.
Ad gratam aciditatem	Ad grat. acid.	To an agreeable sourness.
Adhibendus	Adhib.	To be administered.
Admove	Admov.	Apply.
Alternis horis	Alt. hor.	Every other hour.
Alvo adstricta	Alv. adst.	The bowels being confined.
Ana	āā	Of each.
Ante cibum	Ante cib.	Before eating.
Aqua	Aq.	Water.
Aqua astricta	Aq. astr.	Frozen water.
Aqua bulliens	Aq. bull.	Boiling water.
Aqua fervens	Aq. ferv.	Hot water.
Aqua fontana *or* fontis	Aq. font.	Spring-water.
Bene	Bene	Well.
Bis in die *or* dies	Bis die *or* Bisind.	Twice a day.
Bulliat *or* Bulliant	Bull.	Let boil.
Capiat	Cap.	Let him take.
Caute	Caute	Cautiously.
Cibus	Cib.	Food.
Cochleare magnum	Coch. mag.	A tablespoonful (½ ounce).
Cochleare medium *or* modicum	Coch. med. *or* mod.	A dessertspoonful (2 drachms).
Cochleare parvum	Coch. parv.	A teaspoonful (1 drachm).
Cola *or* Coletur	Col. *or* Colet.	Strain.
Collyrium	Collyr.	An eye-wash.
Coloretur	Coloret.	Let it be colored.
Compositus	Co.	Compound.
Congius	Cong.	A gallon.
Continuantur remedia	Cont. rem.	Let the medicine be continued.
Coque, Coquantur	Coq.	Boil, let them be boiled.
Cras, Crastinus	Crast.	To-morrow.
Cras mane sumendus	Cras mane sumend.	To be taken to-morrow morning
Cujus, Cujus-libet	Cuj.	Of which, of any.
Cum (with abl. case)	C.	With.
Cyathus	Cyath.	A glass.
Cyathus vinarus	C. vinar.	A wine-glass.
Debita spissitudo	Deb. spiss.	A proper consistence.
Decubitus	Decub.	Lying down.
De die in diem	De ed. in d.	From day to day.
Diebus alternis	Dieb. alt.	Every other day.
Diebus tertiis	Dieb. tert.	Every third day.
Dilue, Dilutus	Dil.	Dilute (thou), Diluted.
Dimidius	Dim.	One-half.

WORD OR PHRASE.	AS GENERALLY WRITTEN.	ENGLISH EQUIVALENT.
Dividatur in partes æquales	D. in p. æq.	Let it be divided into equal parts.
Donec alvus soluta fuerit	Donec alv. sol. ft.	Until the bowels shall be opened.
Dosis	D.	A dose.
Drachma	Dr. *or* ʒ	A drachm (60 grains).
Durante dolore	Durant. dolor.	While the pain lasts.
Eadem (fem.)	Ead.	The same.
Ejusdem	Ejusd.	Of the same.
Enema	Enema	Enema *or* Clyster.
Fac *or* Fiat	F. *or* Ft.	Make, let be made.
Fac pilulas duodecim	F. pil. xij.	Make 12 pills.
Fervius	Ferv.	Hot.
Fiant chartulæ xij	Ft. chart. xij.	Let 12 powders be made.
Fiant pilulæ xij	Ft. pil. xij.	Let 12 pills be made.
Fiat emplastrum vesicatorium	Ft. emp. vesic.	Let a blister be made.
Fiat massa, et divide in pilulas xij	Ft. mas. div. in pil. xij.	Let a mass be made, and divide it into 12 pills.
Fiat pulvis in chartulas xij dividenda	Ft. pulv. in chart. xij div.	Let a powder be made to be divided into 12 papers.
Folium	Fol.	A leaf.
Gargarisma	Garg.	A gargle.
Gradatim	Grad.	By degrees, gradually.
Granum	Gr.	A grain.
Gutta, Guttæ	Gtt.	A drop, Drops.
Guttatim	Guttat.	By drops.
Harum pilularum sumantur tres	Har. pil. sum. iij	Let three of these pills be taken.
Haustus	Haust.	A draught.
Horâ decubitus	Hor. decub.	At bed-time.
Horâ somni	Hor. som.	At the hour of sleep.
Horæ unius spatio	Hor. j spat.	After one hour.
Idem	Id.	The same.
In dies	Ind.	Daily *or* From day to day.
Infrico	Infr.	To rub in.
Intime	Intm.	Thoroughly.
Jecur	Jecur	The liver.
Linimentum	Lin.	A liniment.
Lotio	Lotio	A lotion.
Macero	Mac.	To macerate.
Magnus	Mag.	Large.
Mane	Mane	In the morning.
Mane primo	M. prim.	Very early in the morning.
Medicamentum	Med.	A medicine.
Mica panis	Mic. pan.	Crumb of bread.
Minimum	M. *or* Min.	A minim.
Misce	M.	Mix.
Mistura	Mist.	A mixture.
Mitte	Mitt.	Send.
Modicus	Mod.	Middle-sized.
Modo præscripto	Mod. præsc.	In the manner prescribed.
Mollis	Mol.	Soft.
Morbus	Morb.	Disease.
More dictu	Mor. dict.	In the manner directed.
More solito	Mor. sol.	In the usual manner.
Ne tradas sine nummo	Ne tr. s. num.	Do not deliver without the money.
Nocte maneque	Noct. maneq.	At night, and in the morning.
Nomen proprium	N. p.	The proper name.
Non repetatur	Non repetat.	Let it not be repeated.
Nox, Noctis	Nox, Noct.	The night, of the night.
Octarius	O., Oct.	A pint (16 ounces).
Oleum	Ol.	Oil.
Omni horâ	Omn. hor.	Every hour.

WORD OR PHRASE.	AS GENERALLY WRITTEN.	ENGLISH EQUIVALENT.
Omni bihorio	Omn. bih.	Every two hours.
Omni quadrante horæ	Omn. quadr. hor.	Every ¼ hour.
Omni mane	Omni mane	Every morning.
Omni nocte	Omn. noct.	Every night.
Optimus	Opt.	Best.
Partes æquales	Pt. æq.	Equal parts.
Parvulus	Parv.	Very little.
Penicillum camelinum	Penicil. cam.	A camel's hair pencil, or brush.
Per (with accus. case)	Per	Through *or* By.
Phiala prius agitata	P. p. a.	The bottle having been first shaken.
Pilula	Pil.	A pill.
Post cibum	Post cib.	After eating.
Pro (with abl. case)	Pro	For.
Pro ratione ætatis	Pro rat. æt.	According to the age of the patient.
Pro re nata	P. r. n.	According to circumstances.
Pulvis	Pulv.	A powder.
Quantum libet	Q. lib.	As much as you please.
Quantum sufficiat	Q. s.	As much as is sufficient.
Quâquâ horâ	Qq. hor.	Every hour.
Quoque	Q. q.	Also.
Quorum	Quor.	Of which.
Quotidie	Quotid.	Daily.
Radix	Rad.	A root.
Recipe	℞	Take.
Redactus in pulverem	Red. in pulv.	Let it be reduced to powder.
Repetatur	Rept.	Let it be repeated.
Scrupulum	Scrup. *or* ℈	A scruple (20 grains).
Secundum artem	S. a.	According to art.
Semen	Sem.	Seed.
Semis *or* Semissis	Ss.	A half.
Semihora	Semih.	Half an hour.
Sesqui	Sesqui	As much again by half.
Sesquihora	Sesqh.	An hour and a half.
Signa	Sig.	Write *or* Mark (thou).
Simul	Simul	Together.
Sine (with abl. case)	Sin.	Without.
Singulorum	Sing.	Of each.
Si opus sit	Si op. sit	If necessary.
Solve	Solv.	Dissolve.
Spiritus	Spt.	Spirit.
Spiritus vini rectificatus	Spt. vin. rec.	Rectified spirit of wine, *i.e.*, Alcohol.
Statim	Stat.	Immediately.
Stet *or* Stent	St.	Let it (or them) stand.
Subinde	Subind.	Frequently.
Succus	Suc.	Juice.
Sumat talem	Sum. tal.	Take one such.
Sumatur	Sum.	Let it be taken.
Sume	Sum.	Take.
Summo mane	Summo mane	Early in the morning.
Talis	Tal.	Such a one.
Tere		Rub.
Ter in die *or* Ter die	T. i. d. *or* T. d.	Thrice daily.
Tinctura	Tr. *or* Tinct.	A tincture.
Tritura	Trit.	Grind, triturate.
Tussis	Tus.	A cough.
Ultimus præscriptus	Ult. præsc.	The last ordered.
Uncia	Unc. *or* ℥	An ounce.
Unguentum	Ungt.	An ointment.
Ut dictum	Ut dict.	As directed.
Venenum		Poison.
Vel	Vel	Or.
Verus	Ver.	Genuine.
Vesper, -eris	Vesp.	The evening.
Vitellus	Vit.	Yelk (of egg).

HYPODERMATIC MEDICATION.

Modern methods of treatment include the use of medicines by subcutaneous injection, by which process the medicine is deposited either in the **cellular** tissue underlying the skin, the **muscular** tissue, or into the more deeply seated organs. This is accomplished by the use of a peculiarly constructed syringe furnished with a hollow, pointed needle, and the method is usually spoken of as hypodermatic medication. The different methods as suggested above will commend themselves to the physician and will be selected in accordance with the demands of his patient; as a general rule, however, the hypodermatic administration is confined for the most part to the treatment of **emergencies**, when the medicament is lodged in the subcutaneous cellular tissues. The **intramuscular** injection of medicaments is preferred where it is desired to obtain the constitutional action of the drug, and when we do not care to get an immediate effect from its administration. In the treatment of **syphilis*** by the use of corrosive sublimate and by calomel this plan has been adopted, and it is said that abscesses are less liable to occur than when the medicament is thrown into the cellular tissue. The suggestion has lately been put forward that not only syphilis might be treated in this manner, but that **other diseases** would show themselves equally amenable to treatment.

The following, from a paper on "The Cause and Treatment of Psoriasis,"† by Shoemaker, may be noted: "The best results which I have observed, however, from the action of **arsenic** in **psoriasis**, are from giving it hypodermatically, care being taken at the same time to keep the skin, alimentary canal, and kidneys active by the hygienic measures, together with the use of diaphoretics, diuretics, and cathartics, if necessary. In administering arsenic hypodermatically, full doses must be given if a good effect is to be expected. The beginning dose should be from one-tenth to one-quarter of a grain of arsenious acid or the arsenite of sodium, increased to one-half a grain every two or three days. The hypodermatic injection in fat subjects can be deposited deep into the cellular tissue, and, in lean individuals, in the muscular tissue. Arsenic given in this manner often acts more decidedly in chronic cases of psoriasis than when administered by the mouth. At times, patients will not permit the use of the hypodermatic needle, and under such circumstances suppositories of from one-quarter to half a grain of arsenious acid or arsenite of sodium, once or twice a day, will at times prove equally as serviceable.

* See "Remarks on the Treatment of Syphilis by Hypodermatic Injections of Corrosive Sublimate," by John V. Shoemaker, A.M., M.D. London Lancet, Sept. 6, 1884.

† Read before the Pennsylvania State Medical Society, Philadelphia, 1888.

While this claim has not been demonstrated by contemporary observers in sufficient numbers to warrant a positive statement of the results to be expected, the evidences are accumulating which indicate that hypodermatic medication might with propriety be adopted in the treatment of quite a number of affections. If the reader will turn to the note upon hepatic stimulants and sedatives, he will find foreshadowed therein the reasons for thus favorably presenting the hypodermatic use of medicines. By this means we avoid throwing extra work upon the liver, excretion taking place by the kidneys, and if the product introduced possesses any antiseptic properties this action will be apparent in its action upon the blood, which it is enabled to reach without the liability of being destroyed by the liver.

The interstitial method refers to the use of medicine in this manner when the substance is thrown into the affected organ, as the liver, the spleen, or into the pulmonary tissue. This plan has many adherents, especially since the discovery of the antimicrobic influence of certain medicaments, but it also has its opponents. The belief has generally prevailed until lately that pus in closed cavities was beyond the power of nature to overcome, and in the case of degeneration and breaking down of pulmonary tissue the antiseptic method, it was claimed, would destroy the activity of the germs of disease. While this proposition is true regarding pulmonary tissue, it does not hold with reference to accumulations of pus in the pleural cavity, in the liver, and in the peritoneal cavity. Collections of pus in the pulmonary tissues are not positively free from contamination by external influences, but the others are entirely so; that benefit might be derived from the appropriate use of antiseptics introduced by means of the hypodermatic needle in both instances is not unreasonable, but the result will depend to a great extent upon the amount of the collection and the vitality of the parts immediately adjacent thereto.

Park, of Buffalo, we believe, was the first to point out that pus in closed cavities containing pathogenic bacteria would be absorbed without surgical interference, and if this observation were not true the probabilities are strong that individual life would be of but short duration. To-day we hear of a physician who has caused septic infection amongst his patients owing to some catarrhal affection; yesterday the report was current that the purulent discharge from the ear of one of the nurses of a hospital has been instrumental in developing an epidemic of puerperal fever, and to-morrow we shall doubtless be aroused to the dangers which surround us by an announcement that we are all exposed to the poisonous matter which is thrown off from the lungs with the air we breathe.

As there is a limit to human endurance from whatever stand-point

we consider the matter, so there is a **limit** to the good we can accomplish by the use of antiseptics hypodermatically administered. When the extent of the affected area is limited, and the general systemic condition favorable, much may be expected from this method ; when the conditions are otherwise relief will scarcely be more than temporary, and at most the treatment will be only palliative.

The **dangers** connected with hypodermatic medication should also be **considered.** However trivial such an operation may appear to the unpracticed practitioner, it carries with it all the dangers which attend upon those that are more formidable. An examination of different text-books shows that occasionally the use of the hypodermatic needle has been followed by most unlooked-for manifestations, and in some cases it has been urged that the medicament used was too powerful, the effect of the **shock** being entirely overlooked. Such being the case, it will ordinarily recur to the physician that his patient should be previously placed in a comfortable position, and that no external influences may affect him the patient will be most favorably affected by insisting upon perfect quiet.

Septic influences must be avoided by the most thorough antiseptic treatment of all **instruments** used, and as it frequently happens that physicians cannot follow out such methods at the time owing to the lack of facilities, boiling **hot water** may be used temporarily instead. By adopting this plan we shall also avoid carrying **contagion** from one patient to another. As a **rule of practice** for those who are accustomed to the use of hypodermatic injections in the treatment of **syphilis,** it cannot be too strongly insisted upon that they should have an instrument for each patient; if this plan is too expensive they ought to be willing to have one for exclusive use in syphilitics, and another for those not so affected.

Abscesses will be met with occasionally, but not at very frequent intervals, provided proper precautions are taken in respect to **antiseptic measures** and due attention is given to the **solubility** and perfect distribution of the medicament in the media selected for its preparation. The **puncture** of a **vein** would be attended with untoward effects, because the whole of the medicament would thus be precipitated upon the heart at one time. Both these **accidents** may be **avoided** by withdrawing the needle a few lines after its introduction into the tissues, and just before depositing the contents submit the syringe to a slight rotary movement, with a view to detect if the point is free from entanglement. By adopting this simple precaution many of the dangers incident to the method are avoided, and, besides, there is a decided lessening of pain to the patient.

In selecting medicines for hypodermatic use, several **rules** are **to be observed.** Among the most important the following may be named :—

Only the most **reliable medicaments** are to be used.

Whatever drug or combination is decided upon should be **freshly prepared,** either with distilled water or water which has been boiled and filtered.

All medicines for hypodermatic use, when not so prepared, should be **preserved** by the addition of suitable **antiseptics.**

Perfect solution of the drug must be secured to prevent the development of abscesses.

Tablet **triturates** containing the exact amount of the drug wanted are **preferable** to extemporaneous preparations, and the few more generally used may be kept indefinitely.

The size of the **dose** should be **less,** as a rule, than when administered by the **stomach,** certainly not more than one-half, and one-third to one-fourth will often be found quite sufficient.

Inflamed tissues and bony protuberances should be **avoided.**

MEDICATED INHALATIONS.—The discoveries of Koch and others regarding the bacilli have given renewed impetus to the use of medicated inhalations, and, although space will not be taken up with a full description of the special methods, which properly belong to a special treatise, the general practitioner requires some suggestions which will be of some practical advantage in enabling him to decide as to the **demand** for medication of this particular kind. For some years now, the whole attention of experimental physiologists has been given to the study of **microbes,** but lately it has dawned upon the minds of the more thoughtful clinicians that possibly the microbes do not altogether produce the bad effects with which they are charged. It has even been shown, **experimentally,** that the microbes themselves may be destroyed, and yet we may have, as a result of the ferment which attends upon their presence, the development of the most **active poisons.** A similar phenomenon may be witnessed in the stomach of the pig after it has been killed; the ferment—that is, the pepsin in the stomach—goes on with its work, and for a time digests just as it would have done had the animal been alive.

If such a **ferment** were actually secreted by the bacteria, it is but reasonable to suppose that it might be **isolated** by the methods now open to investigators; but Kühne in 1877 decided against this theory, as he was unable to extract any ferment such as he had been able to do with his investigations of the pancreas. Later investigations, however, by Bitter, Sternberg, Vaughan, and Brunton, show that Kühne was in error, and that **bacteria** liquefy gelatin by means of an **enzyme** which not only can be isolated, but has also been found to remain active after the microbes from which it was obtained have been destroyed. It has been demonstrated, further, that this ferment is similar to the ferment

obtained from the pancreas, in that it is most active in alkaline solutions, —a fact which may enable us to account for the actively poisonous symptoms which follow its supposed entrance into the blood. And this brings us to mention again the probabilities as regards the value of medicated inhalations.

Admitting that enzymes find their way into the blood, and that they are subsequently deposited in the tissues, and, in the case of a diseased condition of the pulmonary tissues, that a suitable nidus is formed for their rapid multiplication, is it possible that much will be accomplished, in the way of interfering with their growth, by procedures which have for their object the destruction of morbid products? The suggestion is advanced that, by reason of the nearness of the medicated vapors or inhalations to the circulating fluid when inhaled, more can be accomplished than when our efforts are directed through the stomach. Again, it is urged that the mucous membranes of the upper air-passages absorb suitable medicines if properly prepared, and that they are active in throwing off poisonous products which are constantly accumulating in the blood, and for these reasons the efficiency of medication conducted in this manner cannot be doubted. For a long time some doubts existed as to the possibility of inhaled substances passing the glottis, but there is now no longer any question on this point, not only for vaporized substances, but for any substance which can be finely divided. This latter observation is fully warranted by the observations of competent observers in this State, who have had under their care persons who had long enjoyed excellent health, but, after a few years' constant exposure to work in certain quarries where grindstones were made, many of them were finally overtaken with a species of consumption of the lungs. Dr. Trail Green is entitled to the credit of making this discovery, although his views have met with strenuous opposition.

Having now admitted the presence of the enzymes as well as the microbes in the healthy as well as the diseased pulmonary tissues, and having admitted, further, that medication could be conducted in such a manner that this particular area could be reached, the question then arises as to whether or not this form of medication will be efficacious when supplemented by tissues which are so active in performing their functions? If it were possible that all of the microbes and enzymes could be marshalled in order and compelled to run the gauntlet of fresh air and medication, our chances would be greatly favored in the warfare against them; but we cannot forget that many of these active agents are constantly engaged in their deadly work, and for this reason, if for no other, we are forced to the conclusion that our treatment must be merely palliative. There still remains to be considered the fact that

nature is conservative, and that **poisons** such as ptomaines and leucomaines do not long continue in the body in a state of health, but are subject to almost constant change; those which are present to-day may be gone to-morrow, and those coming to-morrow may in a few days give place to others which may or may not be harmless; and so it goes on from day to day. During an attack of **pneumonia**, for example, the physician finds that one day the symptoms of the patient are more favorable, but the following day there may be a change for the worse, and he is unable to account for the differences which occur from day to day. The older practitioners were wont to look upon this manifestation as an indication of the presence of a **malarial element**, and accordingly quinine was given; but they had no idea of the influence of the **phagocytes** and of the **microbes**, and their children, the formidable enzymes.

Treatment by inhalations should be conducted with a view to its effect upon the tissues with which the medication comes into contact, and the objects for which its administration is followed; no substance should be inhaled which cannot be safely absorbed by the delicate tissues without affecting their integrity, and, from the fact that it would be difficult to counteract the effect of a lethal dose when taken in this manner, the interests of the patient will best be conserved by care on the part of the physician in deciding upon the amount of the dose.

But medicated inhalations are **not confined** to the treatment of pulmonary affections, but may be used with great benefit in the treatment of catarrhal conditions, although some of the present methods are justly open to **criticism.** Vaporization and the inhalations of hot steam cannot be otherwise than hurtful, because by this method the tissues are unduly relaxed, and the system thus is rendered less able to resist unfavorable influences, and, doubtless, to this source may be traced many of the weak throats which are constantly coming under the observation of the general practitioner. Incipient **specialists** are much given to the use of atomizers, more probably for the purpose of impressing their patients with their ability to manage a machine than because they really expect to accomplish great results from a method which carries with it the causes which are well calculated to **undermine** the vitality of the tissues. For a like reason it is not advisable to use any preparations in this form which will have a tendency to destroy the tissues owing to their **destructive action**; this will cover the use of solutions of iodine, nitrate of silver, and the vapor of carbolic acid. With these and other **precautions** which will naturally suggest themselves to the thoughtful physician, the use of medicated inhalations will, doubtless, be attended with results in the main satisfactory, if not always **brilliant**, but for particular instructions upon the subject the reader is referred to special treatises, which are

better calculated to enlighten him in respect to the affections which are most successfully treated by this method.

ALIMENTATION.—Believing that in many instances the regulation of the diet of sick persons is productive of **injury,** owing largely to its being too restricted, the following remarks have been prepared more for the purpose of indicating certain **general rules** to be followed, with a view to have the diet of the invalid selected in accordance with the demands of the stomach rather than in conformity with certain rules such as we observe in dispensing our medicines. This appears the more necessary from the fact—which cannot be denied—that frequently **disease follows** upon certain self-imposed regulations concerning food which in the end prove decidedly unfortunate for the patient. While we cannot wholly overlook the **testimony** of such authors as Salisbury, who has made extensive observations concerning the direct and remote effects of certain kinds of food, the fact remains that few physicians are in a position to control their patients, nor have they the necessary data to be able to determine themselves the actual demands of the system; but the present work does not admit of more than a brief reference to this subject.

There is one **form of aliment** which has had universal employment for centuries past, and still must be accepted as the best, because all attempts to add to our methods of nutrition have been with a view to supply something which shall be as nearly like it in its composition and effects as is possible for human ingenuity to imitate nature, and its superiority is still maintained. We refer to the use of **milk,** without which it would be almost impossible to conduct many of our cases to a successful termination. Still, there are times when this form of nourishment cannot be given, or the patient rebels against it, and we must seek for something which shall take its place. The **reaction** which has lately set in **against milk** may be due in part to the discovery of Professor Vaughan of an active poison which he has named **tyrotoxicon,** but the development of this poison should not cause its wholesale rejection. A more cogent reason, perhaps, is to be found in the interest taken in this matter by manufacturers who have something in the way of a **substitute** to offer, but all such preparations should be used with caution, because they are no more certain to be free from the objections urged against the milk than is the milk itself. If a poison is liable to develop in milk which has not received proper attention in the matter of cooling, it is quite as likely that a similar accident may befall the **artificial preparations** which are offered to supplant it. With proper care in the selection of the product, there need be no fear apprehended from the judicious administration of good milk when it agrees with the patient; but **caution**

is required that the milk may not be condemned by reason of the development of poisons after its ingestion,—a supposition which is not altogether without foundation, and which will be better understood by an examination of the preceding pages. It is impossible for us to say how soon, or at what period after the milk is ingested, it may come into contact with **bacteria**, or their ferments called **enzymes**, when the whole aspect of the matter is changed.

What is true of milk is also true of all the digestive ferments, and applies with equal, if not greater, force to artificially digested products. But **peptonized foods** in great numbers and varieties are now on the market, and doubtless many of them are efficient; but they are not entirely free from the dangers apprehended from the use of milk. In the case of organic affections of the stomach it would be unsafe to use any food which had long been prepared, providing that food had been of domestic origin; and thoughtful physicians should not forget that a similar rule should be applied to foods which have been allowed to stand in the shops for indefinite periods.

Peptonized foods may be used temporarily, but when first exhibited they should be **carefully guarded**, and, as far as possible, they should be obtained as **fresh** as can be, in the hopes of avoiding cadaveric alkaloids. The use of such preparations, however, should not be too long continued, from the fact that they become objectionable to the patient, and, besides, they permit the normal functions of the stomach to remain in abeyance. A good plan will consist in the alternate use of peptonized and some other food when the condition of the stomach will permit of this exchange. Occasionally it will be found that this may be effected by means of the method known as **gavage**; that is, the food is introduced into the stomach in a liquid form by means of an œsophageal tube; and those who have given the matter attention claim the best results from **forced feeding.**

With the intention of supplying the general practitioner with suggestions regarding the preparation of suitable food for the sick, a number of **formulæ** have been compiled, which, it is believed, can be adopted in almost all cases, on account of their simplicity. True, they are not numerous, nor are the dishes very extensive, but they are such as will appeal to the palate of the invalid, and will be found of great advantage when copied and placed in the hands of attendants who are not practical nurses, and it is strongly advised that they be used frequently for this purpose. Many of them are prepared according to formulæ which can be understood and remembered, and with a little instruction from the physician, when demanded by the condition of the patient, most of them may be made more digestible by means of **peptonizing**; and by this process the artificial foods of the shops may be made at the fireside of the patient.

Feeding the sick is a matter of no small moment, and the physician in charge should always make that a part of his business at the regular calls, as the amount of food taken in the twenty-four hours is frequently of greater importance than the amount of medicine. This observation is warranted from the fact that there is a disposition amongst the laity to follow closely the directions of the physician in everything pertaining to the administration of medicine, but the supply of food, we regret to say, is often entirely forgotten. Indeed, some persons get so excited when any of their family is sick that they not only forget to take food themselves, but they never think of the needs of the sick in this respect, and it may be to the advantage of the sick person that the doctor himself should examine and taste the food prepared.

In all cases of **fevers** the instructions to the nurse concerning the kind of food and the frequency of its administration should be given with deliberation; and, in case there are any special reasons for adopting certain regulations, this matter must be specially impressed upon the attendant. **Night-feeding** is something which will sometimes require an explanation before the attendants are convinced of the necessity for administering food to an invalid early in the morning or late at night; but in all cases where the vitality of the patient is at a low ebb this important suggestion should not be omitted. From two to five o'clock in the morning are **critical hours** for the patient, and every precaution should be taken to prevent the strength from being dissipated for the want of proper **food** and **stimulants** at that period. During the day the **intervals** should not be too long apart, but regularity must be followed, and too much should not be given at one time. When but little is taken the periods may be shortened, and, as the patient takes more from time to time, the intervals may be gradually lengthened, as, if the quantity is considerable and the intervals short, the stomach will soon be overworked, and unnecessary time will be lost waiting for it to regain its normal condition. Where medication does not interfere with digestion, it is well to time the periods of administration so that both procedures may be attended to at the same time, and we thus avoid arousing the patient at a time when he might be favored with rest. Special instructions are sometimes required on this point, as certain medicines give better results when taken fasting. An **invariable rule** on the part of nurses should be that no dishes nor medicines shall be in sight of the patient,—symptoms which act as a constant reminder of his illness, and which doubtless have the tendency to turn the thoughts in the direction of the possibilities of recovery. The most heroic patients are often thus affected with gloomy forebodings; but what must be the feelings of the confirmed invalid when he considers the unfavorable outlook?

RECTAL ALIMENTATION AND MEDICATION.—When the condition of the stomach is such that food cannot well be taken in the usual manner nor by gavage, we have to improvise the rectum for the purpose, and in the use of drugs it often happens that medicines which would not have a favorable action upon the digestive functions can better be administered by the rectum; and we are thus frequently enabled to maintain life and continue medication for considerable periods through the medium of this channel. In the use of food in the form of **nutritive enemata,** a few words only will be necessary. The same food, substantially, which is taken into the stomach of the sick person, can be given per rectum, with the expectation that the active principles thereof will be absorbed, and that the stools will be well formed; but in the majority of cases it will be better to submit the intended preparations to the peptonizing process before their introduction. **Absorption** is thus made certain, and, besides, we avoid the possibility of the undigested food acting as an irritant and preventing further effort in this direction. In the **use of milk** in this way it will not be necessary to first submit the product to the peptonizing process, as the circumstances are quite favorable to it after introduction. It will, therefore, only be necessary to combine with the milk a sufficient quantity of pancreatin to produce the desired effect, when, by means of a suitable syringe, the whole amount can be deposited in the rectal pouch, with the expectation that digestion will be promptly carried on. The same method may be adopted with advantage in ordinary cases of illness accompanied by gastric derangement, when the stomach refuses to perform its functions in the usual manner, and will be found especially valuable in the **treatment of children.** A small quantity of milk can be prepared at a time, the few drops of pancreatin added, when it should be administered. The warmth of the stomach will be found quite as efficient as the usual method of peptonizing; and we thus avoid placing in the hands of inexperienced persons the performance of complicated operations, such as that of preparing artificially digested food. In this way **no difficulties** arise concerning the time required for the completion of the process, and **no dangers** arise regarding the possible formation of poisonous products from long standing, such as occurs when a large quantity is prepared at a time.

As a **preliminary** to the administration of nutritive enemata, we must consider the **form** and **amount** of the substance which is to be used. If the substance has not been peptonized, it will be advisable to submit it to that process, or the substance should be of such a character that no difficulty will attend upon its introduction into the rectum. This is a matter of no little importance, as the introduction of any material which is not readily assimilable will produce untoward effects and will set up

irritation which may be difficult to control. There are many preparations of beef to be found on the market, either simple extracts or peptonized products, which may be used with satisfaction; and our main difficulty in this matter is to discover products which shall possess **nutritious** characters, and at the same time be such that the mucous membrane will tolerate them for a sufficient time to enable absorption to take place. The amount should not exceed at any time more than **two ounces,** and the **frequency** of administration must be determined by the condition of the bowel. If alimentation can be conducted in this manner as often as every four hours, that will be the time; but it may be necessary that the intervals should be longer, and much benefit will be derived from injections of this character at intervals of six hours.

The greatest obstacle will be owing to the irritation which is set up by the introduction of the substance into the bowel in the early efforts in this direction; and it has been suggested that the best way to overcome this would be the use of opium suppositories for the purpose of counteracting the tendency to **tenesmus,** but the case may be such that the use of opium is contra-indicated. Cocaine might be substituted; but that is open to objection, because it would have a tendency to destroy the healthy condition of the mucous membrane, and, besides, we could not avoid the constitutional effects. Occasionally it will be found that the use of an enema of cold water will be sufficient for the purpose, and when this does not suffice it would be well to try the effect of a small quantity of **laudanum,**—not more than ten to twenty drops for an adult,—which may be combined with the preparation to be used. This simple method has often proved quite successful in the hands of the authors in the use of nutritive enemata, as well as in the administration of medicinal substances. Cases which have shown excessive irritability under these conditions have developed a wonderful tolerance when this method was adopted.*

Stimulants may be given in this manner in combination with the necessary medication when the patient is weak and everything depends upon maintaining the vitality for the time; and the small amount of anodyne contained in the laudanum will often have a beneficial, rather than an unfavorable, effect upon the general condition of the patient, as we have already pointed out the sedative, as well as the stimulant, action of this drug. Compliance with the suggestions enunciated does not require the paraphernalia of a laboratory, and may be used to great advantage by those who are not so situated that they can call to their aid at any time all the most approved methods.

* See "Rectal Alimentation and Medication in Diseases of the Skin," by John V. Shoemaker, A.M., M.D. Transactions of the Ninth International Medical Congress, vol. iv, p. 170.

DIETARY FOR THE SICK.

MEAT BROTHS.

Beef-Tea, No. 1.

Take one pound of lean beef and mince it; put it, with its juice, into an earthen vessel containing a pint of clear water at a temperature of 85° F., and let the whole stand for one hour. Strain well through stout muslin, squeezing all juice from the meat; place on the fire, and, while stirring briskly, slowly heat the liquid just to the boiling-point. Then remove at once and season with salt.

When administering this be careful to stir up whatever sediment may be present.

Beef-Tea, No. 2.

Take one pound of rump-steak; chop into small pieces; free it completely from fat and tendon, and put it, with one pint of clear, cold water, into a covered saucepan. Let it stand in a cool place for three hours; then let it simmer gently for fifteen minutes, when it will be ready for use. The meat used should be as fresh as possible, and the saucepan should be enameled on the inner surface.

Beef-tea must never be allowed to boil; and in re-heating be careful to raise it only to the proper point for drinking.

Beef-Tea in Fifteen Minutes.

Scrape one pound of lean beef into fibres, and, after placing it in a clean saucepan, pour on half a pint of boiling water; then cover the saucepan closely, and place it by the side of the fire for ten minutes; next strain into a teacup; place this in a basin of ice-cold water and remove all fat from the surface of the liquid, first with a spoon, and finally with a piece of stale bread or blotting-paper; then pour into a warm cup, and heat gently to the temperature for drinking.

Beef-Essence.

Thoroughly mince one pound of rump-steak; place it, with three tablespoonfuls of water, in a mortar; pound it well, and put it aside to soak for two hours. Then put it, with a pinch of salt, in a covered earthen jar; cement the edges of the cover with dough, and tie a piece of cloth over the top. Place the jar in a pot half full of boiling water, and keep the whole on the fire, simmering, for four hours. Then, through a coarse sieve, strain off the liquid essence, which will amount to about six ounces.

One teaspoonful will be sufficient for a young child.

Beef-Tea, without Heat.

One-third pound lean beef, minced very fine; place it in fourteen ounces soft water (cold), to which has been added a pinch, or about eighteen grains, table salt and three or four drops muriatic acid; stir with a wooden spoon, and set it aside for an hour, stirring occasionally; then strain through a gauze or sieve, and wash the residue left on the sieve with five additional ounces of cold, soft water, pressing it so that all the soluble matter will be removed from the residue. Mix the two strainings, and then the extract is ready for use. Drink freely every two or three hours.

Beef-Juice.

Broil a juicy round-steak (cut thick); when seared, cut into small pieces, put it in a lemon-squeezer, and squeeze out all the juice while hot. Add salt. When serving, immerse the vessel containing the juice in a pan of hot water for a few minutes.

Raw-Beef Juice.

Take one pound of sirloin of beef; warm it in a broiler before a quick fire; cut into pieces half an inch square, and, after placing in a lemon-squeezer or meat-press, forcibly express the juice; remove the fat that rises to the surface after cooling. This may be given warm or cold, and seasoned with a little salt, in doses of one teaspoonful every two hours to a child of six months or a year old. The meat must never be actually cooked.

Raw Beef.

Cut a tenderloin beef-steak into the finest possible pieces, and free it as nearly as may be from particles of fat; then place in a mortar and pound until the meat becomes pulpy; next rub through a fine sieve and season with salt and a little black pepper.

A teaspoonful of this pulp, three or four times daily, will be sufficient for a child one year old.

Mutton-Broth.

Lean loin, one pound (exclusive of bone); water, three pints. Boil gently until very tender, adding a little salt or onion, according to taste; strain into a basin, and, when cold, skim off all the fat. Warm when served. Should rice or barley be used, they must be thoroughly boiled and added when the broth is heated for use.

Chicken-Broth.

A small chicken, or half of a large fowl, thoroughly cleaned, and with all the skin and fat removed, is to be chopped, bones and all, into small pieces; put these, with a proper quantity of salt, into a saucepan, and add a quart of boiling water; cover closely and simmer over a slow fire for two hours; after removing, allow to stand, still covered, for an hour, and strain through a sieve.

Calves' Feet Broth.

2 calves' feet;
2 quarts cold water;
1 egg, beaten up with two tablespoonfuls milk for each cupful of broth;
Pepper and salt.

Boil the feet to shreds; strain the liquor through a double-muslin bag; season to taste, and set by for use as you need it. Warm by the small quantity, allowing to each cupful a beaten egg and two tablespoonfuls of milk. Give a good boil up to cook these, and serve with thin, crisp toast. If the patient can take it, a dash of lemon-juice improves the broth.

Clear Brown Soup.

Cut a shin of beef in pieces; put it into a saucepan, with just enough water to cover it; when it boils, skim it and add a bundle of sweet herbs, a little carrot, turnip, onion, and celery, also a little pepper and salt. Let the whole boil until the meat is quite tender; then strain, and let it stand till the next day. After clearing it thoroughly from fat, heat it again, adding as much browning as will make the soup the color you like. Beat up two eggs, with their shells crushed, till they are quite a froth, and put them into the soup with a whisk; let it boil gently for ten minutes; then strain it through a cloth, and it will be perfectly bright.

Consommé.

Make a beef-broth by taking one or two pounds of beef, according to the strength required, from the leg, round, or chuck; wash well; cut in pieces and put on to boil in three quarts of cold water. While boiling skim frequently, and, when reduced to one quart, take from the saucepan and strain; after which return to the saucepan, with a few thin slices of onion, half a pound of lean beef, chopped fine, and well mixed with three raw eggs; beat all thoroughly with the broth, which is to be returned to the fire and boiled for about half an hour, or until perfectly clear.

Oyster-Soup

Drain one pint of oysters through a colander for five minutes, to remove the liquor, and then pour over them one pint of boiling water, which must be thrown aside; add to the liquor already drained a pint of boiling water, and put over the fire in a porcelain-lined saucepan. Boil until all the scum has risen and been skimmed off; then add half a pint of fresh milk, one water-cracker rolled to a powder, a piece of butter, and a little salt and pepper; boil ten minutes, and, just before the soup is to be served, turn in the oysters from the colander and let them scald for three minutes.

Peptonized Oysters.

Take half a dozen large oysters with their juice and half a pint of water. Heat in a saucepan until they have boiled briskly for a few minutes. Pour off the broth and set aside. Mince the oysters fine, and reduce them to a paste with a potato-masher in a wooden bowl. Next put the oysters in a glass jar with the broth which has been set aside, and add the contents of a peptonizing tube. Let the jar stand in hot water, or in a warm place, where the temperature is not above 115°, for one and a half hours. Next pour into a saucepan and add half a pint of milk; heat over the fire slowly to boiling-point, and flavor with salt to taste, and serve hot.

SHIRRED EGGS.

Butter a sauce-dish, and into it break two eggs; put into the oven until the white sets; serve in the saucer with salt and butter.

EGGS.

An egg beaten light, and mixed with a glass of milk, is very good for an invalid who can eat nothing solid. The yelks of eggs, when cooked, should be eaten by invalids, the white being less easily digested.

STUFFED POTATO.

Roast a large white potato; when well done remove the inside and put it into a warm bowl; add two tablespoonfuls of cream and a piece of butter, and salt to taste; beat with a fork until very light, and then replace in the skin and serve hot.

TAPIOCA-PUDDING.

Wash two tablespoonfuls of the best tapioca; soak in fresh water over night; add a little salt, a pint of milk, and simmer until quite soft; beat the yelks of two eggs with half an ounce of sugar; stir into the tapioca and milk, first having allowed the milk to cool, and bake in a slow oven.

SAGO-GRUEL.

2 cups water;
2 tablespoonfuls sago;
3 teaspoonfuls white sugar;
1 glass of wine;
1 tablespoonful lemon-juice;
Nutmeg to taste, and a pinch of salt.

Put the sago in cold water, and warm by setting in a saucepan of boiling water. Stir often, and let it soften and heat for one hour. Then boil ten minutes, stirring all the while; add the sugar, wine, and lemon, and pour into a bowl or mold to cool. Eat warm, if preferred. The wine and nutmeg should be omitted if the patient is feverish.

ARROWROOT-CUSTARD.

Two cups of boiling milk; three heaping teaspoonfuls arrowroot, wet with a little cold milk; two tablespoonfuls white sugar, beaten with an egg; one egg well beaten. Mix the arrowroot-paste with boiling milk; stir three minutes; take from the fire and whip in the egg and sugar. Boil two minutes longer; flavor with vanilla or rose-water, and pour into mold.

CHICKEN-JELLY (VERY NOURISHING).

Half a raw chicken, pounded with a mallet, bones and meat together;
Plenty of cold water to cover it well,—about a quart.

Heat slowly in a covered vessel, and let it simmer until the meat is in white rags and the liquid reduced one-half; strain and press, first through a colander, then through a coarse cloth. Salt to taste, and pepper, if you think best; return to the fire, and simmer five minutes longer. Skim when cool. Give to the patient cold,—just from the ice,—with unleavened wafers or crackers. Keep on the ice. You can make into sandwiches by putting the jelly between thin slices of bread spread lightly with butter.

MILK-JELLY.

Heat one quart of milk with one pound of sugar, and when the sugar is dissolved continue the heat at a boiling temperature for about ten minutes. Now cool it well, and then add—slowly stirring—a solution of one ounce of gelatin in a cupful of water. Next add the juice of three or four lemons and three wine-glassfuls of wine, brandy, or other liquor. Set the glasses containing the mixture in a cold place, so that the contents may gelatinize. It is necessary to have the milk quite cold before the other ingredients are added, as it would otherwise curdle.

ARROWROOT-WINE JELLY.

1 cupful boiling water;
2 heaping teaspoonfuls arrowroot;
2 heaping teaspoonfuls white sugar;
1 tablespoonful brandy or 3 tablespoonfuls of wine.

WINE-JELLY.

1½ packages of Cox's gelatin;
1 pint of cold water;
Juice of 3 lemons;
White of an egg;
Rind of 1 lemon.

Let the gelatin soak in the water one hour; then add three pints of boiling water and one pint of wine (sherry usually, though any kind may be used) and two pounds white sugar. Run into cups or bowls, and let it stand in a cool place till it hardens. (Strain all through a fine sieve before slicing in the rind of the lemon). Oranges or even fruit pieces of any kind may be used in place of the lemon.

GELATIN.

Buy the Domestic gelatin in sheets from the druggist. To make a small quantity for a "bonne bouche" for an invalid, take three sheets, or one ounce, dissolved in one pint of warm water. When it is thoroughly dissolved, bring it to a boil, adding one half-cupful of sugar, the juice of a lemon, and the white of an egg. Beat it well, and put on ice. Remember, a tablespoonful served in a dainty dish may persuade your patient to ask for more; but a bowlful will never accomplish that purpose. The eyes of invalids sometimes seem to act as stomachs to digest before the mouth receives.

CURRANT-JELLY.

Like ice-cream, the ordinary currant-jelly is too sweet for invalids, but this recipe may please any invalid:—

1 pint currant-juice;
1½ pints cold water;
1 tablespoonful sugar;
1 lemon (juice only);
1 tablespoonful Cox's gelatin.

Pour a half-pint of boiling water on the gelatin to dissolve it. Add the other ingredients and set on the ice to freeze.

TAPIOCA-JELLY.

1 cup of tapioca;
3 cups of cold water;
Juice of a lemon and a pinch of the grated peel;
Sweeten to taste.

Soak the tapioca in the water four hours; set within a saucepan of boiling water; pour more lukewarm water over the tapioca if it has absorbed too much of the liquid, and heat, stirring frequently. If too thick after it begins to clear, put in a very little boiling water. When quite clear, put in the sugar and lemon. Pour into molds. Eat cold, with cream, flavored with rose-water and sweetened.

RESTORATIVE JELLY.

½ box Cox's gelatin ;
1 tablespoonful powdered gum arabic ;
½ pint port wine ;
Juice of 1 lemon ;
3 tablespoonfuls of sugar ;
2 cloves.

Soak all together two hours. Put the bowl of ingredients in a basin of boiling water (to keep from burning). Stir until the mixture has melted, boil a moment more, then strain through flannel jelly-bag, and put to cool. The port wine may be replaced by any other liquor, or beef-essence, if preferred. If beef-essence is substituted, omit lemon and sugar and use salt. A spoonful at a time is sufficient for patients too ill to swallow much.

LEMON-SYRUP.

5 lemons ;
8 pounds crushed sugar ;
3 ounces citric acid ;
3 quarts water.

Roll the lemons ; peel and squeeze them. Use only one-half the peel. Boil with sugar and water fifteen minutes, having removed all seeds. Pour into a jar, put in the acid while hot, and stir until dissolved. Let stand until next day. Bottle and keep cool. A tablespoonful to a glassful of water makes delicious lemonade.

WINE-WHEY.

Let one cupful of fresh milk come to a boil. Stir in one-half a wine-glassful of sherry wine. Boil a moment longer, strain as soon as it curdles. Put on ice to freeze ; or, if used as a warm drink, serve at once.

TOAST-WATER.

Slices of toast, nicely browned, without a symptom of burning. Enough boiling water to cover them. Cover closely, and let them steep until cold. Strain the water, sweeten to taste, and put a piece of ice in each glassful. If physician thinks it safe, add a little lemon-juice.

MILK-PUNCH.

1 tumblerful of milk, well sweetened ;
2 tablespoonfuls best brandy, well stirred in ;
1 egg well beaten.
Give very cold.

APPLE-WATER.

1 large, juicy pippin,—the most finely-flavored you can get ;
3 cupfuls cold water,—1 quart if the apple is very large.

REFRESHING DRINK IN FEVER.

Four ounces tamarinds, four ounces raisins ; boil in three quarts of water, slowly, for fifteen or twenty minutes, or until the water is reduced nearly one-fourth ; then strain, while hot, into a bowl with a lemon-peel in it. When cool, use as a drink. A little sugar may be added.

DRINK IN CASES OF DIARRHŒA.

A coffee-cupful of browned, coarse cornmeal, boiled in sufficient water to make it as strong as coffee. Drink as warm as possible.

EGG-NOG.

(Strengthening for convalescents.)

1 egg;
1 tablespoonful white sugar;
1 tablespoonful water;
1 tablespoonful milk;
1 tablespoonful wine or other liquor.

Beat the white of the egg to a froth; then beat in the sugar; next the yelk; then the milk, wine, and water.

EGG-LEMONADE.

White of one egg, one tablespoonful pulverized sugar, juice of one lemon, one goblet water. Beat together.

SAGO-MILK.

Three tablespoonfuls sago soaked in a cup of cold water one hour; add three cupfuls boiling milk; sweeten and flavor to taste. Simmer slowly for half an hour. Eat warm.

BAKED MILK.

Put half a gallon of milk in a jar and tie it down with writing-paper. Let it stand in a moderate oven eight or ten hours. It will be like cream, and is very nutritious.

PUNCH WITHOUT LIQUOR.

Take the juice of six oranges and six lemons, adding sugar to suit the taste. Put to this a quantity of pounded ice and some sliced pineapple, pouring over it two quarts of water. This is an agreeable summer beverage for anybody, sick or well.

RICE-MILK.

2 tablespoonfuls rice;
1 teaspoonful corn-starch;
2 pints milk.

Boil in a farina-boiler until each grain of the rice becomes saturated and the whole creamy in color.

OATMEAL-WATER.

First prepare an oatmeal-porridge; take a heaping teaspoonful of this, put it into a quart of cool water; heat, with constant stirring, to the boiling-point, and strain. This may be used in milk-foods as a substitute for ordinary water if constipation be present.

PEARL-BARLEY JELLY.

Put two tablespoonfuls of washed pearl barley into a quart saucepan with a pint and a half of clear water, and boil slowly down to a pint; strain, and allow the liquid to set into a jelly. Used for the same purpose as barley-water.

RICE-WATER.

Put two tablespoonfuls of rice, thoroughly washed, into a quart of water, and place near the fire, where it may soak and be kept warm for two hours; then boil slowly for one hour, or until the water is reduced one-half, and strain. Useful as a diluent for milk in cases of diarrhœa.

PART II.

Remedies and Remedial Agents Used in the Treatment of Disease not Properly Classed with Drugs.

ELECTRO-THERAPEUTICS.

KNOWLEDGE OF ELECTRO-PHYSICS THE TRUE BASIS OF ELECTRO-THERAPEUTIC PRACTICE.

When we venture upon examination of the present condition of the science and art of electro-therapeutics, although we cannot altogether be said to enter a labyrinth without a clue, for study is a clue to lead us out of difficulties into as much of day as is known on a given subject; yet such is at the present time the maze of conflicting opinion in the literature of the subject that members of the medical profession generally recoil from profound investigation of it. They rely, in their practice, if it includes electricity at all, which is by no means universal, upon treatment embracing procedures with which they chance to be familiar, without aspiration or hope of enlarging their sphere of observation, and extending their practice in the employment of a remedial agent with which they are dealing. Provided as the medical profession now is with apparatus of admirable construction, when only a few years ago it had comparatively nothing thoroughly adapted to convenient electrical treatment, it has sometimes seemed to us that even those who have adopted electricity in their practice may be fitly likened to excellently armed soldiers, who, save in remarkable exceptions at home and abroad, are, in respect of knowledge of combating disease with electricity, a notably awkward squad.

Although there is now, since treatment by electricity has gone beyond the sphere of charlatanism, much agreement in the profession among skilled electro therapeutists as to where its use is indicated, still we also find among them great disagreement as to its diagnostic and therapentic value in particular cases. Although we are perfectly agreed as to the pharmacology, concerning the specific physiological and therapeutic effects of certain drugs upon the human body; while we are not so profound as to be able to say why quinine has a specific effect on chills

and fever, there is by no means such agreement, nor anything approaching it, regarding the various effects of the administration of electricity, and therefore not the same sure basis for rational treatment. In a word, unlike the case of the materia medica, where we have long known, both physiologically and pathologically, the specific effects of drugs, even although not always specifics, in electro-therapeutics we physicians know of the action of electricity much more through incipient pathological experiment than through physiological work, and much more through the latter than through the principles of electro-physics. Yet it is evident that the practice of electro-therapeutics can never reach an art comparable to that attained in other departments of medicine unless the ground-work of knowledge is electro-physics, upon which to superpose a knowledge of electro-physiology, and then of electro-therapeutics. We ask the question of our own experience, how this most desirable object can be accomplished during the longest, at best short, collegiate term of the future, and we answer ourselves and others by saying that it can be accomplished in no other way than by establishing in each college a chair of electro-therapeutics. With this, and the electro-clinical operations that would be combined with it, the student of medicine would reach, within moderate limits of time, just as he now does under the instructions of the present chairs of medicine and surgery, the best theoretical and practical knowledge of the day, to be supplemented, as in the other cases, by future observation, study, and practice.

ELECTRICITY BELONGS TO THERAPEUTICS, NOT TO THE MATERIA MEDICA.

Many writers speak of electricity in its therapeutical applications as belonging to the materia medica. This is not consonant with our conception of the agent of which we are speaking. In cautery, puncture, and excision, accomplished by the determination of heat to small current-resisting surfaces, through the instrumentality of a powerful current, electricity is, of course, employed as a distinctively surgical procedure, and its action does not fail to fulfill our expectations in many cases which were impracticable by other means. But it accomplishes nothing more in these cases than could be secured by the actual cautery, if the site of the disease admitted, except through the peculiarity of its nature incidentally to check through coagulation excessive effusion of blood. Its advantages in many cases, in excision and other things, over the actual cautery are manifest, and it is adapted to many internal operations impossible to ordinary surgical procedures. But this class of operations, being, as we intimate, distinctively surgical, the materia medica should not enter into our conception of them. We go further, and say that the idea of the materia

medica should not enter into our conception in connection with the administration of electricity, even if we exclude the idea of the distinctively surgical applications of electricity. It is true that general or partial innervation and nutrition often follow certain methods of treatment by electricity, but these, so far as we know of them in essence, follow from causes so remote from analogy to the effects of drugs that we should have as much right to consider fresh air, light, and exercise, and, with much more reason, **massage,** as belonging to the materia medica, as to designate electro-therapy as belonging to a category in which we have associated things so alike, pointing to aims based upon experience, that the propriety of their assemblage as classified is self-evident, and open to the lowest comprehension. Physiologically, the **currents** that are **applied** to to the human body are, speaking generally, and at present solely as to their **effects,** irritative, electrolytic, thermic, cataphoric, and catalytic. The **most manifest** of these effects, from beginning to end of operations not surgical, are the irritative and electrolytic. Yet, inclusive of all is the **dynamic, molecular effect** of the current, which is not at all open to casual observation, and which is, notwithstanding, the parent of all the effects of which current electricity is capable in electro-therapeutics, but of which it would in this place be premature to speak.

QUALITIES EXHIBITED IN THE EFFECTS OF THE CURRENT.

We wish here, in speaking of the **relative effects** of the current in electro-therapeutics, to be understood as speaking strictly in general terms. Although, in electrical treatment, the dynamic will prevail over the chemical effect of the current in percutaneous applications, yet, when we have to deal with the mucons membranes, as, for instance, in dilatation of the urethra for removal of **stricture,** the chemical effect, the minor effect, of the current rises relatively to the other in the scale of importance. This is due to two causes: In mechanics, time is one of the elements, and in this latter operation the time is short. In **percutaneous** administration of the current, on the other hand, the horny layer forming the scarf-skin presents great resistance to the passage of the current, which, being thereby diffused, has its density, upon which active chemical change depends, greatly lessened; whereas, when only mucous membrane is opposed to the current, the energy of the current, meeting small resistance, is concentrated upon a small area, and produces the highest **electrolytic** effect as opposed to the existing chemical combination immediately in its track. For methods of procedure in the particular operation to which reference has just been made, the reader cannot do better than to refer to the writings of Newman on the subject, and to his clinical **demonstrations** at the Medico-Chirurgical College of Philadelphia. He

will there see that, through concentration of a very moderate current at the seat of stricture in the urethra, **obstinate cases** are readily **relieved**, and that this is evidently accomplished chiefly through the chemical effect of the current, known as electrolytic.

CHEMICAL CHANGE CONFINED TO SMALL AREAS IN TREATMENT AT THE SURFACE OF THE BODY—THE RELATION OF THE OTHER EFFECTS.

It is very evident that, as active **chemical change** can take place only in the vicinity of the poles of the battery, because the most heroic treatment must still recognize that life is incompatible with currents beyond a certain strength, and that, as the longest sitting ought not to be very long, the chemical change in the fluids of the body produced by percutaneous and other applications must be **very small.** It is only when we can concentrate the chemical change within a limited area, as in the illustration given, that the chemical effect is perceptible, and is not so dissipated as to be virtually non-existent; always, be it understood, with the qualifications as to the strength of the current, the time of its administration, the weight of the person, and other considerations. The **thermic effect** must be in quite the smallest relation to the total effect of the current, being due to the **resistance** of the tissues of the body to the passage of the current, the increase in animal heat being due to work performed by muscular contraction, the increase of circulation being entirely a secondary effect. Considering, too, the firmness of some of the tissues as compared with others, and the density of all, and the small portion of the current which passes in its divided paths with the density with which it leaves the electrodes, and not losing sight, either, of the circumstance of the short duration of the current during an ordinary sitting, it is very evident that its **cataphoric action** must be very small, especially as the tendency to osmosis has to contend with the normal arterial, venous, and capillary movements throughout the body. The **catalytic,** as a consequence of the electrolytic effect of the current in percutaneous administration, must be very minute, and yet, in its application to the mucous membranes within the limited areas covered by the poles, is all-sufficient for accomplishing the absorption desired.

THE TONIC VALUE OF THE COMBINED EFFECTS OF THE GALVANIC CURRENT.

There are things about which we may reason and reach perfectly justifiable conclusions from *a priori* considerations, if we do but reach them by true induction from what we actually know, and the above conclusions are among such as we are justified in holding as derived from

the knowledge which we already possess. No one nowadays doubts the existence of the luminiferous ether, although he never saw or shall ever be able to see it; or the existence of the atom, although he never saw or shall ever be able to see one, or even its inclusive molecule; or the truth of the nebular hypothesis, which accounts, while nothing else will, for the whole solar system. We know in general the structure of the body; we know, even if in a limited way, its integument, tissues, bones, and general characteristics, at least sufficiently to enable us to judge of the **relative resistance** offered by its different parts to currents of electricity.

We know, because electro-physics proves, that electricity forces fluids through membranes by what we call osmotic action. We know, for we see, the convulsive movement of muscles under the influence of the steady current or of voltaic intervals. We know that in all machines, including the human body, work liberates heat, and that moving muscles mean work, whether they move voluntarily or involuntarily. **Experiment** has shown us that chemical change is produced everywhere near the poles of the galvanic battery, when such fluids as are contained in the body offer themselves to the action of the current; and we not only know that in the body all the nascent products cannot recombine at once, but we actually see at once the catalytic action of the current on the mucous membrane. We therefore have the right to conclude that we know qualitatively, and in a rough way quantitatively, what we can here never know precisely, what are the relative values of the various factors with which we are dealing in the administration of electricity. But that is very far from saying that we know what are the relative weights of those factors in the effects that we produce, or at least the relative weights of all of them. The reader will please bear in mind what we have said, namely, that we do not recognize in the application of the electric current any selective power in the physician as regards effects produced, except when, in cautery, everything is subordinated, or almost so, to the production of heat. The nature of electricity being what it is, not one of its effects can be eliminated, however short the duration of the current.

What we contend for is, that although the relative value of these effects is unchangeable, be the duration long or short, yet inasmuch as the therapeutical application of the current is necessarily short, the **molecular dynamic effect** of the current, the most obvious manifestation of which is muscular contraction, is the most **potent factor** in general electro-therapeutic practice. Even if we should consider this molecular dynamic effect as merely resulting in contraction of muscles and stimulation of nerves (although it is now proved that muscle is contractile under the current, irrespective of the vitalizing nerves), observe to what that alone would

lead in functional change, through general innervation and increased circulation growing out of passive exercise.

THE NATURE OF ELECTRICITY.

It stands to reason that one utilizes a force, great or small, in proportion to his understanding of its nature, capabilities, and limitations. In **electricity** we have **a force** different from other forces in that, for the most part, it seems everywhere and yet nowhere; and only now and then, although we are able to localize its manifestations by the simplest means, does it seem to be manifesting itself in nature. It is not generally manifest, as gravity and heat are; we must generally summon it to our presence, and in one form, as the Genius of the Arabian Nights obeyed the bidding of Aladdin, it comes upon rubbing of the Lamp. Other forces we know of and deal with daily. An axman exactly measures the capacity of the tree to resist his strokes; that is, he knows his force in relation to its resistance. Man is in everything anthropomorphic. We know that a horse is about sixteen times as strong as a man, and we rate our steam-power in horse-power. We gauge, not inaccurately, what chance a bull would have in a contest with an elephant, but do not jump from housetops, because we know our jumping-gauge for all directions accurately. Yet, while electricity, which we summon at will and store, is a force of such subtlety and power that it taxes our comprehension and control, it is one which, although long used in medicine, is even now but beginning to be employed scientifically through what one should suppose ought to have been fundamental belief in accuracy of dosage, however the judgment as to that might have erred. This point we have reached, where empiricism is, as far as possible. being discarded. Some of the foremost medical men are advancing in the science of electro-therapeutics upon the basis of electro-physics and electro-pathology. favored by the possession of excellent instruments. The medical world at large has for the first time the opportunity to advance with solid front in the footsteps of these pioneers in science, possessed of their valuable contributions to electro-therapeutics, and armed with the best instruments, including electrometers, without which no physician has greater right to administer electricity than he would have to prescribe unmeasured and unweighed drugs.

When we speak of becoming acquainted with the nature of electricity, of course we mean no more than an acquaintance with its character as dimly seen through its action. No man will ever know what electricity really is, any more than he will ever know what light or heat really is. It is to the partial significance of its actions that our knowledge must ever be strictly limited. But certainly as to its character,

in a measure discoverable through what we become convinced of through its action, we have made great advances in our knowledge within late years.

THE ONE-FLUID AND TWO-FLUID THEORIES.

Although we are compelled to employ still, under penalty of not expressing ourselves as we would, terms which no longer represent our conceptions on the subject, we are yet able to combine entirely **new conceptions** with these **original terms.** Few electricians now believe electricity to be one fluid or two fluids, or a fluid at all, as it was originally conceived to exist. Few, therefore, can believe what follows from the first conception, that there is in electricity current analogous to current as we are acquainted with its existence in fluids. Few now believe that there is any essential difference in the nature of electricity, whether called static, dynamic, or induced, although many still believe in the existence of two electricities having repulsion for each other. What we can now say with positive certainty is, that the terms **static** and **dynamic,** as **applied** to electricity, represent merely relative ideas; that so-called static electricity moves, even while we are calling it static, and therefore, because it moves, has force, although that force is inappreciable to us, and that it may in a small fraction of a second become unmistakably dynamic. It, like dynamic electricity and **magnetism,** induces electricity in its vicinage, which we have no reason to think differs from other electricity.

We cannot but admit that whether electricity consists of but one so-called fluid, or of two so-called fluids, its behavior is as if composed of **two electricities,** and however much we may deem it probable that there is only one electricity in fact, and almost inconceivable that there should be two, we must, for convenience sake, if for no other, give our consent to regarding it as the manifestations of two opposite electricities. Inconceivableness, as is clearly seen in the argument between John Stuart Mill and Herbert Spencer, is not the ultimate test of truth, but it is, nevertheless, the unavoidable test at any stand-point of knowledge during examination for truth, for unless at a given stand-point of knowledge all else has been submitted to the criterion of conceivableness in the selection of parts for conviction we could reach no conclusions. Our conclusions, however, should always admit the mental qualification that they may be modified through further study of a subject. That conceivableness embodies a valid argument, as being one the binding force of which we cannot escape, is proved by the fact that all our arguments in investigation must fall back upon it as of final resort to authority for belief. Happily now, through the ascertainment within but comparatively a few years of the relation of forces to each other, we have reached knowledge of principles which render impossible for the future

such radical changes as had up to that period occurred with reference to views of phenomena. Conceivableness, however, must hereafter, as heretofore, ever remain a valid term referring to our own personal knowledge so far as commanding the knowledge of our day. Even Newton himself, although he had made the grandest of all discoveries in that of the attraction of gravitation, said that he could not conceive of bodies acting at a distance upon each other, implying what he and many more modern philosophers have believed, despite the fact that the attraction of gravitation seems to contradict it, that there is an ethereal medium of communication and force representing gravitation among bodies.

THAT ELECTRICITY AND MAGNETISM ARE THE SAME IS A FALSE ASSUMPTION.

A writer whom we met only lately starts out boldly with the assumption that magnetism is electricity. His ground for this assertion is that magnetism will produce (or, as it is technically described, "induce") electricity, and electricity magnetism. But the conclusion does not follow from that fact, as does the conclusion that two things are equal to each other which are equal to two other things that are equal. Equality, in this case, is axiomatically derived, in the other it is assumed, or, in other words, the question is begged. Magnetism may be electricity, and electricity magnetism, but the case is **not proved** because electricity induces magnetism and magnetism electricity. With as much reason might one contend that heat is electricity. The cases are exactly parallel, for it has been proved that heat induces electricity; but it is not, therefore, concluded that heat is electricity. On the contrary, it is known that heat is a mode of motion; electricity is also a mode of motion, another mode of motion. Mediately, through action on matter, electricity is induced by heat, and so likewise, mediately, through matter, electricity induces magnetism and magnetism electricity, but always through the intervention of matter. There is no more reason to suppose that electricity and magnetism can be directly converted into each other than to suppose that heat and electricity are transmutable into each other. The intermediary is always matter, and these forces disappear and re-appear in other forms, conditioned upon their respective effects upon matter, which involves the particular constitution of the matter itself.

MOLECULAR DISTURBANCE ASSOCIATED WITH ELECTRICITY.

Modern investigation points to the fact that all substances have distinctive **molecular constitution,** and that many of them are molecularly susceptible of profound disturbance. In the case of **metals** this takes the form of a large range of movement among their component mole-

cules, varying in various degrees for different metals. The existence of this movement, which many experiments and deductions confirm, is believed to be a movement of the molecules on their axes, producing the effect at one extreme, which we call polarity, and at the other of non-polarity, of the molecules constituting the body. Coincidently, in electrical or magnetic phenomena, with this condition, is the greater or less liberation of the forces which we call electrical or magnetic. In **dynamic electricity** the molecular agitation may be sufficient to produce strains so severe as to disrupt and fuse the body, or in electrolysis to resolve the molecules into their component atoms, causing them through their **natural affinities** to seek new combinations. Now, whether the force which we call electricity is one extraneous to the molecules, the agent compelling the molecules, or resides in the molecules themselves, are unsolved questions; but it seems probable from all that is known that the force is immanent in matter itself, becoming apparent to our senses under certain conditions which nature at large may produce, or which we may at our own pleasure bring about. It should seem that the **ultimate forms** of matter which we intellectually cognize have inherent in them always, but latent sometimes, the capacity of liberating force in a form that we call electricity, a force just as distinctive as that of the attraction of gravitation, to which it is, as we prove in the case of static electricity, curiously related, in that, as Coulomb's torsion balance proves, the attraction in static electricity is directly as the surface and inversely as the square of the distance, while the attraction of gravitation is directly as the mass and inversely as the square of the distance.

THE BLENDED CHARACTER OF PHYSICAL AND CHEMICAL CONSTITUTION.

We are compelled, in obedience to the **laws of thought,** to examine subjects piecemeal long before we can make combinations of the results of our reflections in the synthetical form. Hence it follows that we have certain molds into which our thoughts are cast, which often appear to us the exact semblance or *simulacrum* of things as they are, merely because they so seem to be, but as they at least partially are not. We think of the **physical constitution** of bodies and their **chemical constitution** as things separate and apart, although it is a fact in our experience that certain bodies brought into the presence of each other have, through certain affinities of their constituent parts, the effect upon each other of changing entirely both the chemical and the physical constitution of each other, so that they become in some cases a single body chemically and physically otherwise constituted from what each body was before. If we take some composite matter and mold it into one body to suit our pleasure, we cannot, of course, arbitrarily prevent its component parts

from asserting their elective affinities, but we can at least temporarily control the physical characteristics of the body. Similarly, in the wide range of nature, matter being generally compounded heterogeneously by other forces besides chemical ones, every element as represented by matter has not found in every individual case the affinity for its utmost satisfaction, because, as indicated, other causes than chemical ones have conspired to give form to matter. Matter, as we find it on the earth, is the product of physical causes other than the merely chemical ones, combined with the chemical ones, and has a physical constitution, derived from those other causes, besides chemical ones, but combined with chemical ones, in its formation. For this reason, the chemical constitution of a body and its physical constitution are not to be separated in idea except when we wish to express ourselves as to the particular formative agency that we may have in mind,—that is, unless we wish to express ourselves with reference solely to the forces which have predominantly combined to give any particular matter form. Matter being of various formative constitution, physical and chemical, is in consequence more or less stable, and the physical constitution so-called and the chemical constitution so-called of a natural body form one constitution, which, while not specifying with respect to the idea of contributive action in formation, is really one constitution with respect to the idea of the blended agency inseparable from its existence at any given moment of time.

THE GALVANIC CURRENT.

The most profound researches lead to the belief that the ultimate form of matter—the atom—represents force in perpetual play, and that the molecules built up from them, especially those constituting metals, are capable of revolving upon their own axes. That there is no real difference between the force chemically impressed upon atoms and molecules by the action of the galvanic battery, and the force impressed outside of the battery, in the outside electric circuit, is apparent through the phenomena of the galvanic current. We confront in the simplest cell a plate of electro-positive metal with one of electro-negative metal, both immersed in an exciting fluid, and attaching a wire to the top of each of the plates, and placing the free ends of these wires in contact with each other, we find an electric current, so-called, flowing from the positive pole of the cell (which corresponds with the negative plate) to the negative pole (which corresponds with the positive plate); and similarly from the negative pole in the other direction. The change that takes place in the cell through the action of the plates upon each other, from being immersed in the exciting fluid, is unequivocally chemical. The whole course of events in the cell until the action runs down, through

the fact of different affinities having been satisfied by new combinations, proves that the effect witnessed is chemical. But the force passing through the wires in the **outside circuit** of the battery is not chemical, it is purely **mechanical.** If it were chemical the wire would suffer, and it does not, unless the force is made so great as to affect its molecular arrangement by fusing the wire, and then the injury would not be chemical, but mechanical. The action in the cell containing the exciting fluid which, to be an electrolyte, capable of resolution by the current, must be composed of such matter as can combine or recombine into two radicals, similar in metals, dissimilar in salts, is engaged in breaking up old and forming new combinations, but in the wires acted on it is doing nothing of the sort; it is merely generating a current in the wires. But, upon dipping the poles, formed by the free ends of the wires, into a receptacle containing another electrolyte, we find that the chemical action intermitted in the wires is resumed in that electrolyte. So we have first chemical action, then mechanical action, then chemical action resumed. What is the **conclusion** to be drawn from these facts?—that in both electrolytes molecules are broken up into their constituent atoms, which are seeking and finding new affinities, and that no such process is going on in the connecting link between these actions. What is the inevitable conclusion, but that force generated chemically is atomic and molecular force, and that atomic and molecular force is, in the presence of proper matter, chemical; that, in fact, the whole agency in play from the first electrolyte, through the wires into the second electrolyte, represents nothing but polarization under a law varying for the anode and the cathode, for one pole as compared with the other, generating the force, immanent in the matter itself, which we call electricity?

SUMMARY FROM PRECEDING CONSIDERATIONS.

This is the statement toward which we have been tending since the introduction of our theme. It becomes us as physicians in the present era of progress, now especially when we ought to strive to remove from the use of electricity all the mystery, and, indeed, mysticism, in which it has been long enshrouded, to understand as thoroughly as possible the nature of the force with which we are dealing; and this much, at least, of its character we can recognize, and in so doing must realize that the knowledge forms the best basis for study of its therapeutic effects. We have chosen to speak of the electricity as derived from the galvanic cell, because it is the generatrix within most general knowledge, and because it best lends itself to demonstration of the conclusions which we have reached. But proceeding beyond that in our investigation, we shall find the **behavior** of electricity everywhere **correspondent.** By means of the

thermo-electric machine and of the dynamo we can produce similar current electricity, having chemical and dynamic effects. Even the faradic current (the alternating, induced current) produces chemical as well as dynamic effects; only, as there is in that current no constant polarity, the polarity alternating rapidly from positive to negative, the nascent chemical products instantly recombine. The disruptive discharge of electricity through an electrolyte shows exactly the same fundamental phenomena.

Everywhere we shall find, elsewhere as well as in static electricity, where even the walls of a room where an electrified body is set up show electricity of opposite sign, that **electricity** is **polarization** of **molecules,** whether of water, air, gas, or metal, or other substances with which it comes in contact. Polarization is static or dynamic according to conditions imposed by nature or man, and if dynamic, is chemical in its effects, if in its path it meets elements within a certain range of combination that have not satisfied their ultimate affinities. In a word, the **action of electricity,** whether galvanic, thermic, electro-magnetic, magneto-electric, frictional, or induced, positive or negative, are all **phenomena** of **polarization,** whether manifested dynamically through current in small conductors, as wires, or statically through films or greater depths of matter.

THE ELECTRICAL CURRENT AS APPLIED TO THE PATIENT.

The ordinary current which we use, derived from the galvanic cell, affords us an instrument in which the body of the patient continues the polarized chain distributed along the lines of least resistance. Some few physicians now use the current of the incandescent light. That of the arc-light is so powerful as to rule it out of any possible attempt to employ it, since a slight mistake in manipulation might cost a patient his life. The **current** pursues a virtually straight **path** when the poles of the battery are closely contiguous, and a variable number of paths, depending less upon the distance of the poles apart than upon the character of the paths between them. We mention this incidentally, from having in mind some of the fatuous assertions which are sometimes made as to **localizing administrations.** We should always remember that, except in the case of the immediate proximity of the poles to each other, we can never make the administrations strictly local by any attempt to localize them. In the path or paths of the electricity, representing more or less intensity of polarization, coincident with different densities of currents, this determined by more or less freedom of passage, it produces in ordinary percutaneous administration, in the order of magnitude as named, irritative, electrolytic, catalytic, thermic, and cataphoric effects. The current, as we have indicated, is **not a flow,** as we know and picture the

movement of fluids to ourselves, unless one should choose to consider slight osmotic action a flow. At any rate, the **osmotic action**, as experiments with fluids in tubes demonstrate, is both exosmotic and endosmotic, and, although it is greater from the positive than from the negative pole, the flow from the negative pole tends to counterbalance the other, both probably being phenomena due to change of density in the fluids acted upon. If the current depended directly upon an electrical current bearing matter along, we should have to account for its excessive slowness, which in that view is impossible.

Excluding surgical applications, where we make use of the current primarily as a heat-producing agent, having some, but less, regard to its chemical effect, which, however, cannot be eliminated, and which, moreover, we do not wish to eliminate—referring now solely to ordinary percutaneous applications of current electricity, it is evident from what we have said that the **inclusive effect** of the current is the **polarization,** in its passage, of molecules in the body, and that the chemical effect, although it must exist everywhere where the current is dense enough to break up molecules, is appreciable to us only at the poles. Similarly, the **irritative effect** of the current, as manifested by tonic and clonic spasm, is appreciable only at the poles, although it is presumable that this effect of the current manifests itself in another form in deeper tissues.

What a powerful agent is this, capable of dynamic and chemical effects, with which we can touch, as with the thrill from the tip of an angel's wing, or blast with the fire of the lowest abyss! And within this enormous range, wherein it has been proved that much healing lies, and whose seeming potentiality beckons us onward to the study of its capacity in cure, what an opportunity there seems to be for patient investigation, through careful experiment and thought upon the subject, to bestow upon mankind one of the largest contributions ever made by the science and art of surgery and medicine! Even as progress in its use now stands among those comparatively unlearned as compared with a probable future, it may be safely affirmed that there is no single curative agency which can parallel the efficiency of electricity in the treatment of disease.

GENERAL CONSIDERATIONS—INSTRUMENTS, PRACTICE, ETC.

Within the compass of the moderate number of pages allotted for the performance of this task there is no space for minute discussion of the relative merits of batteries and instruments, and for detailed reports of numerous applications through cases treated. What we are mainly seeking to accomplish is to describe briefly the nature and general therapeutic value of electricity. Knowledge of the former is in our view no less important than the latter, and for any comprehensive grasp of the

subject is even more so, for, as we have indicated, the only **true basis** for medical practice with electricity is an understanding of so much of electro-physics as may belong to the character of electricity for therapeutical purposes. The books are full of descriptions of batteries, instruments, and of clinical and other cases, often mixed—too much mixed—with historical accounts of successive discoveries, bewildering the reader with a multiplicity of details prejudicial to the concentration of his attention upon important principles. It is to these that we would chiefly direct and confine his attention, leaving many details to his future studies. For this purpose he will find many excellent treatises, such as Erb's, Althaus's, De Watteville's, and Beard and Rockwell's. There are now, too, many admirable electro-therapeutical instrument-makers, and necessarily they make excellent batteries and instruments because they have the ability to do so, and because the best electro-therapeutists are ready to buy them. So simple in their mechanism are even the most elaborate batteries, that a slight explanation as to the mode of managing them suffices. But although the instrument-maker himself may presumably be supposed equal to explaining the mode of working his own batteries and appliances, and be ready for the consideration of purchase to impart his knowledge, there is a line beyond which he is not to be expected to pass. It is not to be assumed that he will give sufficiently minute descriptions of the significance of the volt, ampère, coulomb, and farad. The rules for the measurement of currents are to be learned, as a general rule, only from treatises on the subject of electricity, and although studies to secure the necessary knowledge need not be profound, whatever it amounts to, must be acquired. Not long since we met in a work on electro-therapeutics a statement made by one physician to another, expressing surprise that two persons, placed successively in the circuit of a battery, caused different deflections of the needle of the galvanometer; as if the resistance afforded by one person were identical, or the same as that afforded by every other person. Yet the skin on different portions of the same individual shows varying degrees of resistance to the current, and poles may have more or less surface contact when placed, removed, and replaced on the same spot in the same individual; and when we come to consider the case of two individuals, not only do differences of specific resistance of integument enter into the question, but the character of some tissues as compared with others, and in the case of general galvanization the size of one individual as compared with another. Would a non-pachydermatous elephant, if such a thing were possible, having an integument like the human skin, be expected, when the current is passed through it, to show by the galvanometer only the same resistance as that given by the body of a child? An **absolute**

requirement of all electrical treatment that is not inconsiderable, in which we may estimate for two or three cells, is the possession of an excellent electrometer and a properly constructed rheostat, for opposing resistances at pleasure in the outer circuit. Excellent electrometers of two different kinds—the upright and the horizontal—can now be obtained. The upright kind has the advantage of everywhere being, from its position, free from the influence of the horizontal component of the earth's magnetism, but the disadvantage, for some purposes, of not being so sensitive as the other galvanometer. On the other hand, the horizontal galvanometer has the advantage of sensitiveness, but the disadvantage of not being so convenient as the other for reading. This defect is now, however, often rectified by some manufacturers by putting inside the lid of the case of this class of electrometers a mirror, which, when the lid is raised nearly vertically, gives a very nearly vertical reflection of the dial of the instrument.

The cells constituting batteries are arranged in so-called series, parallel arc, or in multiple arc, depending upon the sort of work they are intended to perform. Later on, we will describe by means of a diagram the order which characterizes in each case these different **modes of arranging** cells. Suppose that we have a number of cells, each containing an element consisting of a plate of zinc and a plate of carbon. When they are arranged **in series,** the electro-motive force is thereby increased to overcome external resistance in the circuit—that is, outside the battery. If they are arranged in parallel or in **multiple arc,** it is to lessen internal resistance in the circuit—that is, in the battery. To arrange cells in series, all that is necessary is to couple the zinc and carbon in one cell to the zinc and carbon in another, in the order, zinc, carbon, zinc, the series ending on one side with zinc and on the other with carbon, to which the attachment of the electrodes is made. If, on the contrary, we wish to arrange the cells in parallel or in multiple arc, we must couple all the zincs of each battery, and all the carbons of each together, and then for each battery an electrode from the combined zincs and one from the combined carbons constitute the two poles of the battery. Without some digression it will be impossible to proceed further to an understanding of the need for diminishing interior resistance for surgical employment of the battery, when for general therapeutic treatment the electro-motive force is to be increased.

UNITS IN ELECTRICAL MEASUREMENTS.

The **volt** is the unit of electro-motive force. The **ohm** is the unit of resistance. One volt acting through one ohm constitutes per second an **ampère current.** Electro-therapeutical administrations deal with milli-

ampères, and the **milliampèremeter,** or galvanometer reading to the thousandth of an ampère, is the instrument in use for that practice. The **coulomb** (static) is a charge of the electro-motive force of one volt in one second. The **farad** (static) is the amount of electricity represented by a coulomb at the potential of one volt. It is physically represented by a Leyden jar of that capacity. The terminology proceeds far beyond this, but the preceding mention is more than sufficient for our purposes. Wherever dynamic, these and other measures have been reduced to the fundamental units of time, mass, and length, which means reduction to the terms of the only absolute force—the attraction of gravitation.

The **volt** is supposed to represent **pressure** as in head of water, and the **ohm** resistance to flow, as in pipes. An ohm would be represented by the resistance of an ordinary copper wire of 95 per cent. conductivity, thirty-two gauge, ten feet in length. The **exact measure** of the ohm in absolute terms, reduced to velocity by reference to gravitation, has not yet been fixed, the different values obtained differing considerably. But for practical purposes its value is sufficiently well known, as an approximation to the truth of absolute measure, for introducing resistances to currents in instruments consisting of coils and other devices.

RESISTANCE: EXTERNAL AND INTERNAL.

When the external circuit of a battery is through a large resistance, its **electro-motive force** is greater than when the circuit is through a less resistance. Coupling the cells of the battery in series, although it increases the internal resistance, increases also the electro-motive force of the battery, all the more enabling it to overcome great resistance in the external circuit (the human body, for instance). On the contrary, when it is intended to deal with internal resistance in the battery, this cannot be accomplished by overcoming it, but by lessening the internal resistance by coupling the cells in parallel or in multiple arc. Why external resistance increases electro-motive force is not known with precision. A portion of the effect is ascribed to the increase of polarization set up in the battery by its own current, and a portion to the probability that the internal resistance is a function of the current. We have not far to go, however, to find **analogies** for this phenomenon. One of the best measurements of the **velocity** of **electricity,** that by Wheatstone, makes its value two hundred and eighty-eight thousand miles per second. The velocity of **light** is only about one hundred and eighty-four thousand miles per second. The Coast and Geodetic Survey, in telegraphing in 1869 from San Francisco to Cambridge, Mass., and back, through a loop of wire seven thousand two hundred miles in length, obtained the time of transit as $\frac{1}{6700}$ of a second. But, then, there was the resistance of the wire and

the retardation from thirteen relays on the route. The fact is, according to the highest authorities, there is **no absolute velocity** to be assumed for electricity, its actual velocity in any given case depending upon the surrounding conditions. In the case cited the resistance to rapid movement was caused by the physical obstacles on the way, but it is equally clear that the possibility of the signal as made was conditioned upon accepting what was obstructive. A similar paradox is presented in the experiment of attempting to pass an electric spark through a vacuum. As is well known, the resistance to the passage of the spark becomes less and less as the air becomes more and more rarified, until, instead of the spark, a mere glow sets in, and then beyond, when a degree of exhaustion of air is reached representing as nearly as possible a vacuum, there is no communication between the poles even across so small a space as the tenth of a millimeter. So here, again, we have transmission conditioned upon opposition, air representing something, a vacuum nothing, and yet an obstacle.

OHM'S LAW.

We will now proceed to the consideration of Ohm's law as a preliminary to the more minute consideration of the subject of exterior and interior **resistances in batteries.** The law of Ohm is that a current is equal in strength to its electro-motive force divided by the resistance to it. The law is **symbolized** thus: $C = \frac{E}{R}$. From this simple equation is deducible that the electro-motive force is equal to the current multiplied by the resistance, or, $E = C \times R$. From it also we derive that resistance is equal to the electro-motive force divided by the current, or, $R = \frac{E}{C}$. So, these three equations enable us to obtain the values of current, electro-motive force, and resistance—C, E, and R—from knowing the value of any two of them.

Beginners are often puzzled to know why $C = \frac{E}{R}$. We once heard a quite intelligent man remark that Ohm's law must be wrong. But, as Ohm's law has been tested by the most refined processes, and accepted as true by the first electro-physicists in the world, ordinary mortals may well content themselves with accepting it. But the truth of it can also be proved by recourse to consideration of general principles. C, E, and R, all imply, besides abstractions, certain **concrete facts.** C is an electric current passing with a certain force, symbolized by E, through a conductor, say a wire of determinate diameter. Other things being equal, that wire will conduct the force proportionally to its cross-section

(diameter squared), which is called the area of the cross-section. At this point, the beginner will sometimes say, "Well, then, if that be the case, why is not the current equal to the electro-motive force, E, multiplied by the area, $C = E \times A$, instead of to the electro-motive force, E, divided by the resistance, R,—resulting in $C = \frac{E}{R}$?" But it *is* effectively multiplied, although through the medium of division. Observe that the ability to conduct in the wire is limited by its resistance to conducting. Hence, the resistance, R, is the reciprocal of the area, A; that is, $\frac{1}{A}$. So, regarding R as the reciprocal of A, we see that the electro-motive force, E, multiplied by the area, A $(E \times A)$, or, the electro-motive force, E, divided by the resistance, R $\left(\frac{E}{R}\right)$, brings the same result. The reason that the form of division, instead of that of multiplication, is adopted, is because division represents better than multiplication that the resistance, R, is an inverse value of the conductivity in the wire or other medium of conduction.

DETAILS AS TO THE RESISTANCES ENCOUNTERED IN THE USE OF BATTERIES. THE EXTERIOR RESISTANCE IS CHIEFLY THE BODY OF THE PATIENT.

We are now prepared to consider rationally the questions of **external** and **internal resistances** for **batteries**, necessarily postponed until some general knowledge on the subject of the relations of conductivity and resistance was imparted.

When batteries are in good condition, the internal resistance is very small as compared with the external resistance imposed for any service which they may be called upon to perform. Indeed, in the case of percutaneous administrations of the current, it is, when the battery is in good condition, so small as to be negligible. In **electro-surgery**, occasion arising for overcoming comparatively slight external resistances, in the heating of the wire loop, needle, or other appliances on which the force of the current is concentrated, there can be little question of external resistance in the batteries used, which are specially designed for the purpose, consisting of large plates arranged to obtain slight resistances in the battery.

Symbolizing an external battery **resistance** by R, and an internal one by r, suppose that, in this case, R is equal to 400, and r to 10.

$$C \text{ being } \frac{E}{R}, \text{ that is, } \frac{E}{R+r}, \text{ then:}$$

For one cell, ... $C = \frac{E}{R+r} = \frac{1}{400+10} = \frac{1}{410}$

For two cells, ... $C = \frac{2E}{R+2r} = \frac{2}{400+20} = \frac{2}{420} = \frac{1}{210}$

For three cells, ... $C = \frac{4E}{R+4r} = \frac{4}{400+40} = \frac{4}{440} = \frac{1}{110}$

By taking a pair of cells instead of one cell, we have nearly doubled the current, and by taking two pairs instead of one cell we have nearly quadrupled it. Yet we have not lessened the external resistance; we have only more and more countervailed it by summoning more and more force to our aid. The **phenomena** here involved in both external and internal resistance of a battery are very **remarkable**, so remarkable that no perfect solution for them has yet been found. The article. "Electricity," in the last edition of the "Encyclopædia Britannica," treats of them as follows:—

"If the electro-motive force and internal resistance of a battery in action were the same, whatever the external resistance, there would be no difficulty in finding the internal resistance by Ohm's method. We have simply to give two different values to the external resistance, and measure the current in the two cases. The electro-motive force does not appear in the ratio of the two current measures; hence, knowing this ratio, we can find the internal resistance. Or, we may use an electrometer, and measure the difference of potentials between the two poles of the battery,—first, when the external resistance is infinite; secondly, when the external resistance is R. Then, if r be the internal resistance, the ratio of the first electrometer reading up to the second is $\frac{R+r}{R}$ by Ohm's law; hence, r can be found. Unfortunately, however, the electro-motive force of a battery is not independent of the external resistance. In general, when a battery is circuited through a small resistance, its electromotive force is much smaller than when the external resistance is very great. This arises from the polarization set up by the passage through the battery of its own current, and possibly in some degree from other causes as well. There is also reason to believe that the internal resistance of a battery is a function of the current."

Now, make the plates forming the element of the individual cell of the battery which we have just discussed twice as large as they were in the individual cell of that battery. Then, of course, the size of the **plates being doubled,** and the distance between them not increased, the internal resistance of the cell will be halved. But, as it is so small, compared

with the external resistance with which we have just dealt, being only 10, the halving of it makes little reduction in the total resistance. The external resistance, 400, of course, remaining as before (and, to illustrate, it must remain as before, as it is, in electro-therapeutics, the resistance which cannot be modified), the slight effect on the battery of halving the small internal resistance is exhibited by the following equation:

Internal resistance in one cell, halved: $C = \frac{E}{R + \frac{1}{2} P} = \frac{1}{400 + 5} = \frac{1}{405}$.

Comparing this equation with the first equation of the last series, it is found that, although the plates have been doubled in area, the current of the cell is virtually the same as before.

DIFFERENT KINDS OF BATTERIES USED FOR DIFFERENT PURPOSES.

It is much more convenient for ordinary therapeutic purposes to have **small cells**, the needed force being more readily procured by bringing more of such cells into the circuit than to use for this purpose **large ones.** The sum of the external and internal resistances, $R + r$, must be the same, no matter whether R is greater or less than r, and R can be overcome only by increasing the number of cells in circuit, while r can be diminished only by increasing the size of the cells. It stands to reason that, by both simultaneously increasing the size of the elements and the number of them, the minimum of resistance, external and internal, may be reached, and therefore the maximum of force obtained. It does not follow, even if internal resistance is a function of the current, that diminishing resistance everywhere where we can will not increase force. **Diminishing** the **resistance** by proper procedures, and then accepting the resistance which is inevitable, we obtain a larger force than if we added to the unavoidable ones those which could be diminished. But what object would there be in galvano-causty, and such methods, for us to proceed beyond a very moderate degree in diminishing the internal resistance of the battery used, when the external resistance is so slight as it is for those methods, a few large elements serving our purpose, or even a single cell with enough exposure of surface? Or, in percutaneous administrations of the current, what adequate object would there be in diminishing in cells in good condition the internal resistance, as well as overcoming the external, when the external resistance, being relatively inordinately great, the internal resistance sinks into insignificance, and mere increase in the number of cells employed will serve our purpose of obtaining all the electro-motive force we need?

Here follows, arranged as a diagram, an illustration of the different modes of coupling cells, represented by the terms, in series, parallel arc, or in multiple arc:—

For series, involving high internal resistance and intensity, the cells are coupled according to the following system : $(+\ -)\ (+\ -)\ (+\ -)$. For low internal resistance and for quantity, the parallel arc coupling is : $\left\{\begin{matrix}+ & - \\ + & - \\ + & -\end{matrix}\right\}$. For low internal resistance and for quantity, the multiple arc coupling is : $\left\{\begin{matrix}+ & - \\ + & -\end{matrix}\right\}\ \left\{\begin{matrix}+ & - \\ + & -\end{matrix}\right\}$. Of course, both arrangements tend toward **quantity,** the first by driving the battery, the second by reducing internal resistance.

TENDENCY TO GENERALIZE FROM INSUFFICIENT DATA.

What strikes one quite as much as anything else in the electrical treatment of disease is a prevalent tendency to generalize from data either imperfect in its character or insufficient in amount, until, if this tendency were not from time to time checked by the writings of eminent practitioners, we might expect to see the science of electro-therapeutics degenerate into beliefs leading to an art as specialized as that of the pseudo-phrenologist, or as effectively generalized as that of faith-cure. The agent with which we are dealing is so strange in its actions that some men lend themselves to its mystery, willing to believe anything of it, and of their own part in an efficiency exalted by their imaginations. Few, like Franklin, when the ailing from Pennsylvania flocked to him for cure by static electricity, take such a just view as he of their powers, when, despite the seductions leading to a contrary belief, in the ascription to him of knowledge in cures supposed to be brought about by him, he accounted for them by travel and change of food and scene, while at the same time admitting that the employment of static electricity might be efficacious in disease if it were administered under proper medical advice. The average man, however, gives free rein to his credulity in all that happens when he is a subordinate agent, and this in everything else as well as in electricity. He believes everything that is found set down in books, irrespective of the author, and, in addition, whatever he imagines himself on a cursory view to have discovered.. Yet so distinguished an electro-therapeutist as De Watteville remarks, even of what is supposed by some persons to be the foundation of knowledge for electro-therapeutic treatment, that " a therapeutical system built on the opposite anelectrotonic and katelectrotonic effects [that is, the differential action of the poles] rests upon an imaginary basis. . . . Both are stimulants, if stimulation there be, the kathode more than the anode." This remark strikes the keynote of correctness of view as to the efficiency

of electricity as a curative agent, as against the incorrectness of view which would regard it as consisting of various tools that can be fitted to one handle at the pleasure of the operator. As has been previously remarked, the current is a force possessing many attributes, among which the operator has no power of selection, but merely, through discreet application, of subordinating some effects to others. The effects of the agent upon the human body, dynamic, anelectrotonic, catelectrotonic (if, as De Watteville says, such there be), electrolytic, catalytic, thermic, and cataphoric, are all immanent in the agent itself, and cannot be eliminated at the will of the operator; nor can their relations be in any way even modified, except through external physiological or pathological conditions which it is summoned to meet, and which, necessarily, are beyond the will of the operator to arrange. The most that the operator can do is to increase, through the mode of presenting the surface of the body (as when he scarifies the skin or presents mucous membrane), the effect of one of the powers of the current; or, to give another example, as when he produces the heat desired for galvano-causty, although, as heat in metals decreases their conductivity, he thereby diminishes the quantity of electricity.

We might expect to find—and really do find among average physicians—a tendency to ascribe particular effects to a too minute degree to some one quality of the current rather than to another, or to its different qualities in the aggregate; and even so trustworthy an observer as De Watteville implies that too much reliance is generally placed upon our knowledge of the relative importance, even if we admit the existence of certain factors which in sum go to make up what we call the galvanic current. The advance in the science and art of electro-therapeutics must be admitted to have been great, but we must guard ourselves against this human tendency to categorize upon imperfect data, and, beginning with hastily defined principles, to assert that this or that particular thing is efficacious here or there, to the exclusion of another which may have been more potent, although even it may not have been chiefly potent, but potent in conjunction with something other than we imagine.

No one has looked more deeply into the subject of electro-therapeutics than has Erb, and yet he admits, despite all the present physiological basis for electro-therapeutics, that it rests even now upon an **empirical footing,** which only the future can extend to a truly scientific one. What can be a more cogent statement, as coming from such a man, than the following extract from his "Hand-Book of Electro-Therapeutics":—

"We may state unhesitatingly that electricity is an extremely powerful and many-sided remedy, and that more evident and undoubted

curative effects may be attributed to it in diseases of the nervous system than to almost any other remedy. The experience of the last thirty years leaves not the least doubt that **electricity** is **valuable** in the treatment of neuralgia, anæsthesia, spasms, and paralysis, in diseases of the peripheral nerves, as in those of the central nervous system, and that its introduction into therapeutics has caused a more favorable prognosis in many forms of disease. I am not guilty of exaggeration when I say that the curative effects not infrequently astonish even the experienced physician by their magical rapidity and completeness.

"Despite these facts, however, we know extremely little of a positive nature with regard to the finer processes in electrical curative effects, or their connection with the, to a certain extent, well-known physiological effects of electrical currents.

"The chief difficulties in this problem appear to me to lie on the pathological side of the question, viz., in our ignorance of the finer nutritive or molecular changes occurring in the nerves in various diseases. We possess scarcely any positive knowledge concerning the real nature and final causes of the so frequent inflammatory disturbances, degeneration, atrophy, etc., of the tissues. And how much less do we know concerning the more subtle processes in the various disorders of the nervous system, in neuralgias, spasms, paralyses, and other manifold neuroses!

"On the other hand, our knowledge of the various effects of electricity is by no means so extensive as many seem to think. We are accurately acquainted only with the irritating and modifying action of electrical currents upon the nerves and muscles; concerning so-called electrolytic effects upon the living animal we know practically nothing, and this is also true of so-called cataphoric action; with regard to our catalytic effects, which are now referred to so frequently, it may be said that they are almost entirely hypothetical.

"And who will affirm that there are not other at present unknown effects of electricity upon the living organism, upon which the most important therapeutic results depend?"*

QUALIFICATIONS TO THE PRECEDING STATEMENTS OF ERB AND DE WATTEVILLE.

Yet, although commending tendency to assumption of an attitude of doubt as to many things alleged regarding the powers of electricity, one should at the same time guard against accepting literally such statements of limitations of those powers as have just been quoted from Erb and De Watteville. They themselves would probably approve the same caution respecting portions of these particular passages to which we have

* Translated by L. Putzel, M.D., New York, 1883.

drawn attention. De Watteville may certainly with propriety question whether there is any demonstrated difference between the poles, such as to warrant, according to one, an anelectrotonic, and to the other a catelectrotonic, effect; but we are really at a loss to understand what he, even judging by his own general views, means by saying of the two poles, "both are stimulants, *if stimulation there be.*" Again, as to a portion of what Erb says, may not exception be fairly taken? May we not answer that we know electrolytic effects from the poles occur in the human body, because we know that they occur when the poles act on fluids similar to those of the body? How can we ever know of them as occurring in the human body, if they do occur there, unless by this inference; and is not this indirect means all-sufficient to establish the fact? Why, too, have we not the right to infer the occurrence of cataphoric action in the body through the same means, when we cannot in experiment suitably place the poles with reference to fluids contained in glass tubes without witnessing cataphoric action? Lastly, is there absent, even as to the living body, no evidence of the catalytic effect of the poles, when we find that application to the mucous membrane, although with only moderate current and trifling heat, is followed by escharotic effect?

CREDULITY PREVALENT IN ELECTRICAL MATTERS.

At the same time, as we intimated, we cannot but applaud what is nowadays said in a cautionary way, even when we deem that the particular utterance will not bear scrutiny throughout, because so much of credulity has mingled with proper belief as to the wonders of electricity. If we would have our armamentarium shine with the light of truth in the eyes of men we must brush away from it as far as possible the cobwebs of fancy which imagination weaves about its strange agency. It is not so long since certain men of education were found in numbers to believe in the efficacy of the **magnet** alone in the cure of disease. Persons there were who were convinced that, under certain conditions, they could see light emanating from it, and many occult effects were ascribed to its exhibition in disease. Now, undoubtedly, as a magnet, to be a magnet, must have a field of force, and that field of force must exert itself on certain lines, unless something be brought within the field to deflect those lines, it is evident that, if we choose, we can so adjust a magnet that its field of force shall impinge upon and enter the human body. But, so far as we are aware, there is no evidence that the force produces any effect that is measurable in vital terms. The investigations of Carpenter all gainsay any such supposition. Yet, for all that, we do not deny that a magnet may have prophylactic and curative power. Carpenter also clearly shows us what potency the mind has through "ex-

pectant attention" in directing, even to a determinate point, a conception of disease, and thereby in influencing the disease favorably or unfavorably. If this be so, as among the various physical phenomena of disease we believe it to be, it is easily to be credited that the mind may exert an inclusive salutary or prejudicial action on the body through its conception of dissipation or encroachment of disease of general distribution. The simplest form in which we recognize this phenomenon is that met by a placebo, which is administered for a limited specific effect. But we may regard placebos more generally as to their action, as in a case which we once met, where a pebble was exhibited as having once been a potato of such virtue that it had shown itself capable of drawing rheumatism from the body, in proof of which there was its hardness, which was undeniable. Horse-chestnuts are sometimes equally efficacious in the same disease, but whatever the medium of cure, or preventive, as when swimming, an eel-skin tied around the leg for prevention of cramp, the real virtue of the application is not to be disputed, if there be faith in its efficacy. We must remember that whatever the article may happen to be, no matter what, it symbolizes the directive action of the mind, aided by the power of imagination, to secure prevention, palliation, or cure, and should, therefore, reserve a proper place in our regard and practice for every apparently different form of faith-cure.

DISPUTED POINTS.

Constantly accumulating evidence from practitioners seems to contradict many of the refinements of electrical treatment which were supposed at one time to be based on observed facts. That one pole is stronger than the other, and that one represents the acid, the other the alkaline resolution of electrolytic matter; that for certain surgical unipolar punctures one is, from this circumstance, better than the other, are the only fundamental facts with which we seem to be positively acquainted. There is no demonstration yet (and it would seem that there could be none) that the **descending current** has always advantage over the **ascending**, or the ascending over the descending. We have already said that, in percutaneous administration of the current, the chemical part of the effects must be among the least, often so small as to be negligible. The reason we gave is conclusive, that the sitting at the longest is short, and that the current which the living body will bear is not sufficiently dense to effect diffused electrolytic change. Even in Apostoli's operations, in which he uses currents so large, the density of the current from one pole is diffused over a large area, and is densely concentrated only near the other. The action to which the human body is subjected in percutaneous administration of the current is nearly, in sum, dynamic. That follows, if

the chemical action at the poles is slight, and we have shown that it must of necessity be then slight. The differential indications of the poles must therefore be, if the chemical effect is admitted to be slight, merely dynamically different; that is, the molecularization set up, the parent of all the effects, whether in the battery or in the wires, manifests itself dynamically differently at the two poles. Then why, the reader may ask, should not the positive pole seem stronger than the negative pole?

Ingress and **egress** of **force** must be regarded with reference to matter. If any one will take a rifle, and fire at any distance at which its bullet will perforate a plank, he will find that the wood at the bullet-hole on the side of the plank nearer to him is smooth, but on the other side splintered. and yet the force deployed had remained essentially the same during the transit of the bullet from one side of the plank to the other. The reason for this is that the bullet, in striking the plank, compacts the fibres of the plank because they are heavily reinforced, but, on the other side, it disrupts the fibres because they are free to escape. The electric current passes through the scarf-skin, through the sweat and sebaceous glands and the hair-follicles, the horny layer forming great resistance, and, after more or less diffusion in the body, concentrates again densely at the opposite pole, and there meets the resistance analogous to that of the further side of the bullet-perforated plank. When the tissues meet the force in ingress they tend to be compacted, but when they meet it in egress they tend to be disrupted. Hence, at the point of egress, the sensation is naturally stronger, but not from the fact of the presence there of the negative pole.

THE MANNER IN WHICH THE CURRENT PASSES.

The previous considerations conduct us much further than to the conclusion which we have reached. Many persons believe that the current flows only in one direction, from the positive to the negative **direction.** But no one will dispute that both **anode** and **cathode** afford electroscopic test of their respectively yielding positive and negative electricity, or that two independent cells, joined positive to positive pole, and negative pole to negative, are neutralized. In the battery the zinc plate furnishes positive electricity to the acid, retaining negative electricity itself. The conducting plate receives the positive electricity. The electricities cannot recombine in the battery, for the battery is engaged in producing them. They therefore flow away, if there are conductors forming an external circuit to receive them. Is it reasonable to suppose that they both flow away through the positive electrode, when the negative electrode is ready to receive one of them?

When there is no external circuit, the electricities are in a static

condition. Accepting Faraday's law, which no one disputes, that it is impossible to produce an absolute charge of electricity of one kind without producing an equal charge of the opposite kind, which all experiment proves, and accepting, what all experiment also proves, that these electricities, although they, as formed, are mutually repellant, are ready to form another equilibrium by combination under other conditions than those which produced them, we find in the battery-cell the same general phenomena as in the frictional or inductive electrical machine, in which the second equilibrium between the electricities is obtained by discharge through its poles, just as the other obtains it by discharge through its poles. The only difference between them is that, in the case of the battery, the equilibrium is restored by gradual, instead of, as in the other, by disruptive discharge, and the current passes through the electrodes in one case and leaps from their surface in the other. But even with the static machine the electrical flow may be made gradual, as will appear later when we come to speak of static electricity. As soon as the static condition in the battery ceases by the completion of the external circuit, the respective electricities flow in opposite directions from the anode and cathode, respectively, to the positive and negative electrodes, respectively, representing the external circuit, returning on themselves to the battery. The reason that they move at all is because the dissolution of the elements of the battery has put in play forces which must continue to act under the conditions of their gradual generation for the restoration of their equilibrium, until it is restored through the destruction of the efficient cause of them. Action and reaction are, it is well known, everywhere equal, and, as has been said, the quantity of positive electricity everywhere generated is in presence of an equal quantity of negative electricity. As between the two opposite electricities, we find in static electricity that the discharge of electricity proceeds from the positive in the negative direction as anticipatory. Hence, we have the right to infer that the propulsive force of all positive electricity is greater than that of negative electricity, and that the positive current is initiatory in the external galvanic circuit, and therefore stronger from the positive to the negative pole than from the negative to the positive pole. It is stronger in the particular manifestation of energy to which we are referring, but not in another sense stronger, for, compared with its corresponding negative electricity, it performs its proportional part, and no more than its proportional part, in liberating and recombining chemical equivalents.

What has previously been said regarding which pole should appear to be the stronger in percutaneous administrations of the current, is conformable with this view as to the movement of the two electricities.

Whether they both move in the same or in opposite directions, the manifestation of force at any given point would be constant, for, whether they move in the same direction or in opposite directions, we cannot suppose, in this case, that there would be interference, the current, whether regarded as single or as twofold, merely representing a molecularly affected chain. The seat of sensation in percutaneous administration of the current being, of course, at the surface of the body, where the positive current enters and where it departs from the body, it meets as everywhere else the negative current. At the skin there is sensation, but in the interior of the body there is no sensation. **Dispersion** of the **current** would partly account for that fact, but, leaving that out of consideration, it is fully accounted for by the circumstance that the interior of the body is not sensitive like the skin. Discarding, therefore, all considerations except as to the points of the skin in contact with the poles, at the positive pole we have the positive current entering and the negative one departing, and at the negative pole we have the negative current entering and the positive one departing. The difference between the **dynamic weights** of the positive over the negative current, added to its disruptive tendency at the point of egress, therefore, would render the sensation more powerful at that point, and that point happening to be at the negative pole, we ascribe to the effect of that pole what should be ascribed to the positive one. So, in fact, when we have been thinking and speaking of differential polar effects, we have at least been mistaken as to which is the stronger pole in the true sense—that as to which pole affords the stronger current—and this, because we have not sufficiently considered, in addition to *a priori* reasons for our conclusions, that ingress into and egress from the human body, of a force like current electricity, present entirely different conditions, and that the **positive** is **stronger** than the **negative current.** The ground over which we have passed would seem to lead us to the conclusion that as, in percutaneous administration of the currents, they are nothing if not **dynamic,** they cannot represent real differential polar effects.

THE ASCENDING AND DESCENDING CURRENTS.

Equal with the doubtfulness as to the existence of peculiar differential polar effects that would warrant the two poles being respectively designated as **anelectrotonic** and **catelectrotonic,** is that regarding the alleged differential effects between ascending and descending currents, when reference is made by those terms to the directions taken in the body by the current. There is use made of the same expression when reference is made to an entirely different matter; that is, when a nerve receives the application of the negative pole at the plexus, and of the

positive pole at its extremity, the current is said to be **ascending**, while conversely, when the positive pole is placed over the roots, and the negative at the extremity, the current is said to be **descending.** That kind of distinction is perfectly legitimate, and is not the one now under consideration, the directions to which we are referring relating to the body topographically considered.

Although, as we have said, the current really moves in two opposite directions, yet, for the sake of convenience, we speak of its direction as being from the positive to the negative pole. Regarding it in that way, it must, however, be obvious that, the human body being formed as it is, administrations of the current will in certain cases be ascending through one part and equally descending through the corresponding part. If each hand of a person holds a pole, the current is ascending in one arm and descending in the other. If one of the poles be at each foot, the current would ascend in one leg and descend in the other. If, however, the positive pole were placed at the nape of the neck and the negative one at the sacrum, and then the positions of the poles were reversed, we should have alternately a descending and ascending current, and so we may say of all cases of which this is a type. But, after all, there seems to be no clearly demonstrated **differential effect** derived from these different modes of administration of the current, even when regarded from this latter point of view; and if we might presume to discuss it merely upon general principles, this could not well be otherwise, for if we reflect that the **transmission** of energy in the case of **electricity** has been determined by the Wheatstone revolving mirror process at two hundred and eighty-eight thousand miles per second, while in the motor nerves of man the nervous current is only thirty-five to forty metres per second, and in the sensory nerves from fifty to one hundred metres per second, we perceive that that is as much as to say that, by comparison with the electrical current, **nerve transmission stands still.** Make any abatement that one may reasonably choose to include for the great resistance opposed by the body to the electrical current, and still the difference between the velocity of nerve transmission and that of the electrical current is inordinate, and therefore gives no ground for supposition that any difference can be impressed upon the nerve transmission as derived from the fact that the electrical current is ascending or descending in the body. It is well to note here that, although the velocity of the nerve transmission is less when the nerve is in an electrotonic than when in a catelectrotonic condition, this may easily be accounted for without resorting to the supposition that there is any truly differential action in the poles, for it is known that the **stimulation** of certain **nerves** is not necessarily productive of **muscular contraction,** but may produce contraction of a blood-vessel,

or modify the secretion of a gland, or inhibit certain nervous action. which might be explained by the difference of dynamic force, with a given quantity of electricity and amount of electro-motive force, of one pole over the other, instead of accepting without further demonstration that one pole is in its effect upon the body intrinsically different from the other.

THE MOOT POINT AS TO WHETHER THE BODY NORMALLY HAS REGULAR ELECTRICAL CURRENTS.

At one time it was supposed by many persons that there are regular electric currents in the body, some going even so far as to imagine that **nerve force** and **electricity** are really the same agency. This latter notion has, of course, been thoroughly dispelled, as the result of the experiments made during the last few years by Helmholtz and other physicists regarding the rate of transmission of **nerve signals.** The results of the experiments of Du Bois-Reymond, pursued in the interest of demonstrating the existence of currents in both nerves and muscles (the prevalent one being supposed to be produced by the muscles, the nerves merely acting inertly as conductors), and also of demonstrating the existence of electrical currents in the arms, coincident with, but distinct from, muscular or nerve currents, interesting as they are, and productive as they will prove in the future, through leading research in that direction, would seem to be entirely disproved by experiments. Professor John Trowbridge, of Harvard, has reached the conclusion that the phenomena observed by Du Bois-Reymond are not owing to the presence of muscular currents and nerve currents in the substances submitted to the action, but to **endosmotic action** of the fluids in the muscular and nerve substance, affecting the saline solution of the cushions adapted to the galvanic battery for the reception of these substances by way of referring their action to that of the delicate galvanometer used for the detection of infinitesimal currents. And in the case of the electrical current supposed to be produced by Du Bois-Reymond by dipping the tips of the forefingers of each hand in two solutions, and then producing muscular contractions of each arm alternately, registering a change in opposite directions on the galvanometer, they are probably rightly ascribed by Professor Trowbridge either to the change in temperature superinduced by the muscular contractions or to a change in the flow of blood in the arms.

Nevertheless, although one who believes in the results of Professor Trowbridge's experiments, as against those of Du Bois-Reymond, is reduced to the necessity of discarding any notion which he may have entertained regarding demonstrated muscular, nerve, and electric currents in

the human body, he is not thereby necessarily driven to conclude that there are no currents whatever of those kinds; nor would he be forced so to think, even if such currents should never be demonstrated, because it would seem, after the experiments of Du Bois-Reymond and Prof. Trowbridge, that it would be impossible to organize experiments looking to the conclusions involved, in such a manner that the results would not be masked by endosmotic action, even if they had any real existence. The existence of **nerve** and **muscular currents** in the body is a legitimate inference, from the fundamental conception that something conveyed presupposes something conveying it. That muscular current and nerve current, if such there be, are not electrical, is clearly shown by the evidence adduced as to the enormous difference in velocity between the conveyance of signals by the nerve force and by electricity. That, however, there are not electrical currents in the body, as well as nerve currents, even if there are no muscular currents save through the presence of nerves, is not to be supposed. The **currents** of which we have been speaking are simply **undemonstrated,** that is all. The discussion was assumed to rest upon the assumption, moreover, that if the electrical current existed, it is one performing regular function as current. The contrary view, which we hold, admits the presence of electrical currents, but not of electrical currents (properly so called) as being regular in their action with reference to nerve or other function.

THE PRESENCE OF ELECTRICITY IN THE HUMAN BODY, SO FAR AS DEMONSTRATED.

The **chemical changes** proceeding in the body, even when inactive, but especially when active, preclude the notion that corresponding electrical conditions are not generated. We know from experiment that electricity in a static condition exists in the body, and that being so, it must constantly take the form of discharge, which means current. Not only are different persons charged with different quantities of electricity, but also with electricity of different signs,—plus or minus,—as is clearly shown by the ability of some persons to communicate and never receive a spark from certain others. Within two or three years we have experimented with a young girl, who was able to communicate to any one whom we found a spark from her knuckles, no one with whom she was acquainted being able to reciprocate the compliment. Hemmer's experiments go to show that in some persons the electricity is positive and in others negative. He says, however, that normally the electricity in the human body is positive, but that this **normal condition** is lessened or entirely changed, by violent exertion or exposure to cold, to one in which negative electricity is present. Positive electricity, he says increases in

winter and diminishes in summer, ceasing with perspiration. He also remarks that prolonged **mental exertion** increases the positive electricity.

The last is the only one of the results mentioned which seems to us anomalous. We are not disputing it, having no grounds from either personal observation or remarks of other writers besides himself for denying the statement. But, although this is so, we may be permitted to say why the statement seems to us anomalous. Hemmer distinctly speaks of lassitude from muscular overexertion as being productive of negative electricity in the body. Yet he ascribes the opposite effect to overexertion of the brain; and it really should seem that, as lassitude from the former cause is as pronounced as from the latter, the electrical consequences could not be different.

Mention of a very **singular phenomenon** should not be omitted in connection with this,—one of excitation of the brain. It is of frequent occurrence after prolonged mental exertion, especially when accompanied by disquiet, and when a period of rest at last supervenes with full intention to recuperate, as when, after a day of mental strain, a person retires for the night, that he becomes aware of a succession of quick discharges in the brain, indicating the liberation of force of some kind. The time at which this occurs, when the mental tension is at least in a measure relieved, clearly indicates that the force which is liberated is one which had been summoned to meet that for which it is no longer required, and, becoming superfluous, is discharged in a series of explosions. That the sensation is represented physically in the brain there ought to be no manner of doubt. As to whether it is electrical or nerve force which is discharged there is apparently small chance of discovering. Our judgment as to its velocity must, as a matter of sensation, be wholly erroneous if the discharge be electrical, for just as the retina retains the picture of the electric spark for some time, although it has the duration of only $\frac{1}{24000}$ of a second, so the nerves of sensation are, in this other case, incompetent to register the duration of the movement, our faculty of differentiating in lapses of time not being equal to perception of difference below the tenth of a second.

TONIC EFFECTS OF THE ELECTRICAL CURRENT.

That the chief effects of the current administered percutaneously will eventually be decided by electro-therapeutists to be **tonic** effects, we have little doubt. All experimentation, clinical observation, private practice, and thought upon the subject seem to point in the direction of that conclusion. What with unhygienic surroundings, improper food, excesses of all kinds, and mental strain, combined with inadequate exercise of many parts of the body, civilization has much to answer for as to the

low general physical condition of the nations. We know that it can be pointed out that within late years, in America, the upper classes of society have advanced in physical well-being, through recognition, even among the female portion of communities, of the desirability of **systematic exercise** and its adoption to a large extent, thus changing to some degree a deplorable condition of things, unparalleled at one time in any civilized country. The one pleasant aspect of the present anglomania among these people is its having led the women of this country to the experience of the salutariness of exercise. Similarly, but to a much greater degree, and long preceding, the young men of the country have gradually become addicted to athletic sports, with the result of increased healthfulness, vigor, and beauty of physique. But there the matter chiefly rests with the youth of both sexes. There is in this country no general appreciation of, or at least addiction to, habits of exercise throughout life, as we find obtaining in most other civilized countries. The average young man, who has contested in many a game through the flurry of college life, drops out after a year or two of sporadic return to exercise upon principle into a person who takes a stroll with a segar,—calling it "a constitutional,"—and feels that he has paid the full debt to nature required for health. And it is even worse with young women, who, for the most part, except under the impulse of some strong extraneous inducement of pleasure sought, cease all thought of constant fresh air and exercise as of things as necessary as daily bread. The topic is a fruitful one, in which we feel that we must stay our pen. In sum: we would say that as a nation we Americans, of any class, are not imbued, beyond the heyday of youth, with love of exercise for its own sake, and in the later years of life do not pursue it systematically as a duty owed to health, but perfunctorily within the narrowest limits.

The immediate consequence of this neglect is entire rest for some parts of the body. A man in middle life will sometimes be surprised to find that, upon taking trifling, unwonted exercise, the muscles of some part are sore where he had hardly dreamed they were employed. He goes on for years with the most moderate employment of his muscles generally, and, although perhaps not fat, is so little inclined to flexure of the body that he dislikes to tie his shoe. As it is a well-known physiological law that organs and parts unused deteriorate from the mere circumstance of their disuse, and even tend to disappear, and that judicious employment of them is essential to their vitality, we can readily see that the tendencies of modern civilization are to deterioration of the race; for although we have in that civilization the condition of the middle estate, where the draughts on life are at their minimum, we have also the class of the highest estate, where the natural draughts are voluntarily

and involuntarily increased, and, lastly, we have the class of the lowest estate, where poverty means to those afflicted with it ill-feeding and inadequate feeding, ill-housing, including ill-ventilation, and all the ills that Pandora's box let loose on earth. A man cannot escape all ills, do what he may. Even the savage, free to roam at least in places yet, and trained in every fibre amid fresh air, has his periods of depression through famine and other evils due to his estate. But in the best specimen of these we can see what is given to the physical heritage of man, if only he could generally be more of a child of nature than he is, if merely to the limitations of the conditions which surround the civilized man. Then he would find that through exercise suited to his individual powers he has strengthened his heart's action, increased his circulation and digestion, lightened his spirit, and made of himself a new being.

In the gradual relinquishment of physical exercise, and yielding to slothfulness in that respect (for many a man willing to labor with his brain is averse to physical exercise, and yet he is of all men the one who most needs it), as age creeps on apace every part of the body becomes more or less enervated, through not being called upon to perform its functions with the proper degree of intensity. The whole vasomotor system suffers in its integrity. We do not doubt that, if we could inspect the internal economy of many a man, it would show a condition of incipient or permanent partial stasis in a transition stage, occurring, overcome, and recurring in fitful change without perhaps reaching the point where embolism supervenes, but always circling about the zones of danger, and threatening that conclusion, from the circumstance of the torpidity of the general action of the system. Now, if the **galvanic current** is fundamentally what we believe it to be in its effects,—**dynamic,**—if it is a current **polarizing** all that it meets on its passage through the body, distending and contracting muscles and veins, causing glands to secrete, moving, through change in the relative density of their parts, the fluids of the body, we have only said in other terms that this must not only **relieve stasis,** but **must produce passive exercise** of the most beneficial kind, especially in all those parts through which the current goes, which, through long neglect of hygienic laws, are functionally deranged. The **primary** curative **effect** of the current is therefore, to our mind, **tonic,** restoring innervation and nutrition to the organism, with the **secondary effects** which we have mentioned.

THE DIFFERENTIAL ACTION OF THE POLES.

We could wish that this view of the fundamental action of the current were universally taken, and then we should see dispelled one of the concomitant notions associated in the minds of young electro-therapeu-

tists with the present absence of any determinate opinion of the cause of the therapeutic action of the current, rather imputing it to some occult, mystic agency. This notion is that the current, to be efficacious, should always be strong. There is, however, only one occasion when the practice conformably with this view is justifiable, and that is where the current, whether galvanic or faradic, is used for diagnostic purposes. But even for certain diagnostic purposes it must be very weak. We should like to see its use for diagnostic purposes extended, and in that case, the purpose not looking toward tonicity, it follows that the current cannot be defined for it as necessarily mild. For detecting **tender points** on the spine and other processes the **faradic current** has long been used, but it might elsewhere be judiciously employed in **general diagnosis** of obscure ailments, especially where there is thought of surgical interference. A case is recalled in which surgical interference took place in a wrong direction, where it seems probable that previous faradic exploration would have avoided the mistake.

To return from our digression to the question of the **amount of dosage**, we would say that the tonic effects of the currents are to be obtained without heroic administration of them, and that the notion of only strong currents being efficacious is one too much like that which the old darkeys used to have as to doses from the **materia medica**, properly to obtain vogue among skillful electro-therapeutists. Every individual case for dosage with electricity should have the same kind of **discrimination** applied to it as in the administration of drugs. The error of view among young electro-therapeutists, which we have pointed out, is of great consequence, as tending to retard general arrival at the most rational practice. Another point, too, which they should sedulously study is the **differential action** of the two **poles.** To apply the **positive pole** for **stricture** is to ruin the urethra, whereas to apply the **negative pole,** under the conditions imposed by so skillful an operator as Dr. Robert Newman, is to effect a permanent cure in a marvellously short space of time. Dr. L. C. Gray, of New York, lately said, in an article in the *New York Medical Journal*, that in spite of his sixteen years' experience with the current he had not been able to notice any **therapeutic difference** between the poles, that if one pole does not agree he tries the other, and if that does not agree he stops electrical treatment. The Doctor here implies what we feel sure from the context he does not believe, that in percutaneous administrations there **may be** therapeutic difference between the poles. He does not, of course, refer to applications of the poles to the mucous membrane. We, in speaking of the proper mode of applying the galvanic current to the urethra, have referred to the care which should be used, in all such applications, to employ the

proper pole. The differential **chemical effects** of the two **poles** are, as applied to the mucous membrane, demonstrable. The differences should be studied, so that the contemplated effect, not an untoward, or even contrary one, may be reached by misemploying them. As for the percutaneous administration of the current, we can only repeat what we have before declared, that the effects of the poles must in that case be infinitesimal, and therefore negligible in the premises. The beginning and end of our first **practical lesson** is that the chief therapeutic virtues upon which we can rely in the galvanic and faradic currents lie in their **tonic effects.**

THE FARADIC APPARATUS AND CURRENT.

We have now come to speak in such a manner alternately of the **faradic** and the **galvanic current,** that it is proper at this point to introduce some description of the **faradic** current, and of the machine with which it is used, as a preliminary to particular mention of when one kind of current or the other is indicated in medical practice. The faradic current is an **induced current,** induced by the **primary** current, perforce of that strange power which electricity possesses of summoning other electricity to manifest itself either statically or dynamically. In the case of **static electricity** the presence of one electricity binds another to its presence for a time, depending upon the condition of the atmosphere, which may dissipate it by convection or conduction, while in the case of **current electricity** the electricity induced by a current is only of momentary duration and is itself a current.

Considerations of the manner in which the simplest and best kind of faradic battery works will instruct us as to the phenomenon to which reference is here made. **The battery** consists of a few small cells, sometimes not more than two, and a bar of annealed iron encircled by a long helix or coil of insulated wire, which, in turn, is encircled by another coil of insulated wire, longer and finer than the wire of the first coil. The outer helix, that in which the induced currents flow, is not connected with the inner one, in which the **primary currents** flow. Opposite one end of the inner coil, and the end of its inclosed bar of iron, which there appears, is a little platinum point restrained by a spring from touching the end of the iron core, which spring is still sufficiently slight and flexible to allow the point play enough from a slight impulse to enable it to touch the end of the iron core. Now, if an electrical current is sent through the wire of the inner helix or coil (the primary coil), there is an instantaneous current in the opposite direction through the outer coil (the secondary coil), and hence its current is called the **secondary current.** But, as the primary current passes through the primary coil, it magnetizes the core of

iron inclosed within it, which causes the platinum point, up to that moment retained by its spring, to overcome the tension of the spring and touch the end of the iron core. This touch, allowing the current to pass through the point and its connections, has the effect of at once demagnetizing the iron core, which instantaneously releases the point to fall back to its old position under the controlling action of the spring. But, when the point falls back to its old position, away from contact with the iron core, the consequent break of the current allows of the iron core being remagnetized. Meanwhile the current in the secondary coil, which had first flashed in the direction opposite to that in the primary coil, at the "break" of the current flashes back in the same direction as that of the primary coil. It thus appears that **induced currents** are **generated** at both "make" and "break" of the primary current, and that their direction is first opposed to that of the primary current, and then conformable to it. It is at the "make" of the galvanic circuit that the current of the secondary coil goes in the opposite direction, and at the "break" in the galvanic circuit that the current of the secondary coil goes in the same direction. By means of the automatic arrangement of the iron core, platinum point, and spring, the "makes" and "breaks" in the current take place with great rapidity, so that the current is really **almost continuous.** But, no matter how rapidly the "makes" and "breaks" of the current succeed each other, the interruptions of the current always generate secondary currents moving in the manner described.

If the soft-iron core were not present, the same phenomena would be producible, provided only some way were devised and adopted for interrupting the current of the primary coil. But, by the inclusion of the soft-iron core two **advantages** are gained,—intensity of action of the currents is much increased, and the soft-iron core, with the addition of its platinum point and spring, serves as the best possible **current-interrupter** for general purposes. A current-interrupter is also called by the various names of **rheotome,** make and break, and **vibrator.**

As the **making** and **breaking** of the galvanic circuit is repeated every time the platinum point touches or leaves the end of the soft-iron core, the induced currents, as well as the primary ones, are constantly renewed, and flow to the electrodes of the machine. It was discovered by Prof. Joseph Henry, that helix after helix of wire might be placed in succession over one another, forming tertiary and other currents, which, however, necessarily diminish in strength as they recede farther and farther from the primary coil, the source of energy. Here it would be well to conclude the subject with the correction of a **prevalent error,** that the coils create energy. But, it is true of them as of everything else in nature which liberates force, that *ex nihilo nihil fit.* What the faradic

and other machines with coils effect is, not the creation of energy, but the causing of a certain kind of manifestation of force. They increase enormously the electro-motive force as manifested in difference of potential.

THE GALVANIC AND THE FARADIC CURRENT TWO TOTALLY DIFFERENT INSTRUMENTALITIES.

It must be very evident to the reader that the distinctive **characteristics** of the galvanic and faradic currents are so **divergent** as to indicate that, if they have therapeutic effects, choice must frequently be made between them to suit particular cases. The characteristics of the currents will, of course, remain constant, and in regard to them the question will be only as to the places of application of the poles, and the intensity of the administration of whichever current may be selected. But, in the present condition of the art of electro-therapeutics, it is often an **open question** as to which current to employ in a special case, included within the ever-recurring question of correctness of diagnosis with regard to that special case. Barring, however, the limitations under which we work, we have in the two currents two diverse instrumentalities in the field of electro-therapeutics, even without including static electricity, and it is for us to seek sedulously to use them to the best advantage, inclusive of indication or contra-indication of either of them, or of both. According to the present tendency of opinion, however, among electro-therapeutists, their **contra-indication** would seem to be very rare, the chief instances of it cited being in **acute mania** and in **pregnancy,** unless it be extra-uterine. The most apparently **diverse symptoms** often seem to be amenable to treatment by the currents, such as anæmic and hyperæmic conditions. And yet, that the currents should affect both of these favorably is not so strange, after all, when we reflect that both conditions are by the currents subjected to **mechanical effects** which are tonic.

For diagnosis and treatment of various forms of **paralysis,** both the galvanic and the faradic currents are often used, their treatment sometimes indicating the use of the two currents alternately. In **general faradization** the current may be passed through the body by means of a moist and warm foot-plate, to which the negative electrode is attached, while the positive electrode, covered with a moist sponge, is placed on the upper part of the forehead. Skillful electro-therapeutists warn us that, in **all applications** to the head, great care should be taken not to have the current **strong** or the application **long,** not to **reverse** the current, if it is galvanic, and, when galvanic, **not to make and break** the circuit while the current is passing. These **directions** as to breaking the circuit and reversing the current do not apply to the **faradic** current,

which is constantly engaged in making and breaking the circuit and reversing the current. But, while the electro-motive force of the medical faradic machine is quite great, the quantity of electricity conveyed by the current is very small,—and so, we may add, it relatively is in all faradic apparatus as compared with galvanic apparatus.

To avoid shock, a hydro-rheostat, or some better form of **rheostat,** should be in the galvanic circuit, and the current should be gradually raised from zero to the desired amount, and then be lowered in the same manner to zero, the poles being placed in position before the current is turned on, and removed only after the current is shut off. As with the galvanic current, so also with the faradic, the poles may be used in a **stabile** or **labile** (stationary or moving) manner. Thus, in general faradization, after the positive pole is placed on the forehead, and the current is flowing, the positive pole is passed down the spine and over the stomach and abdomen, over the arms and, if convenient, over the legs, always avoiding, in making sharp turns around the joints, shocking the sensitive nerves of the skin at those points through the concentration of the current upon them.

CAUTIONARY WORDS AS TO THE ADMINISTRATION OF THE GALVANIC CURRENT.

We have already spoken of the method of using the **ascending** or **descending** current for the purpose of causing the reaction of special muscles, and bringing them from a condition of quiescence into automatic action. The ascending current, it will be remembered, we specified as meaning the current passing from the positive pole, placed over the peripheral portion of the nerve, to the plexus, and the descending current as meaning the current passing from the positive pole placed over the plexus of the nerve, to the negative pole, at the peripheral portion of the nerve. A current may be continued so long in one or the other of these directions as to **destroy** the **tonicity** of the nerve, which will require rest, or stimulation in the opposite direction, in order to restore it. This fact does not conflict with what has been previously stated as to its probably being a matter of indifference, as to effects, whether a current is ascending or descending, with reference to the body generally. It is entirely reconcilable with and confirmatory of that statement. The current, in passing through the body, generally meets various conditions, neutralizing special and blending them into general effects, whereas we have, in the case of a certain muscle, excited through its nerve, a specialized concentrated effect, associated with the maximum density of the current, as compared with the current dispersed on many circuits in its course throughout the body.

GREATER CARE TO BE TAKEN WITH THE ADMINISTRATION OF THE GALVANIC THAN WITH THE FARADIC CURRENT.

It cannot be too carefully kept in mind that greater precautions should be used in the administration of the galvanic than in the case of the faradic current. The effect of the faradic current upon the skin and sensory nerves is so great that it at once proclaims its presence and its strength. Not so with the galvanic current. A considerable current may be passing through a patient without his feeling any sensation whatever, unless a break should occur in it. Then is produced the **sensation of shock** to which we have already referred, unpleasant at best, sometimes terrifying; with a strong current, more than disagreeable, and with a very strong one, **dangerous.** Therefore it is that, unless the current is known by the electrometer, by the small number of cells in circuit, or by some other test, to be very moderate, it should be as gradually as possible increased, with the electrodes already in position, and just as gradually decreased, before either of them is removed from the body.

TESTING FOR PHYSIOLOGICAL REACTIONS, TO COMPARE WITH THEM PATHOLOGICAL ONES.

The muscles on symmetrical parts of the body can, in health, be excited by the same strength of current for each side. Hence, as we are possessed of the physiological fact that they are irritated to contraction, and to the same amount of contraction, under the same strength of current, we can utilize the knowledge for diagnosing many real and simulated affections. In the case of employing the faradic current for these purposes, it is usual to place one pole at the particular part to be tested for, or exercised in, reaction. As the **polarity** of the current is with the faradic apparatus continually being **reversed,** the rapid alternations of the current may not give the muscles time enough for **clonic spasm,** but may throw them into a **tetanic** condition. If, however, one choose to employ a faradic apparatus in which the interruptions to the current can be made at longer intervals than is possible with the small automatic apparatus, he can produce with it clonic spasm of any but the most diseased muscles.

ACTION OF THE CURRENT IN CASES OF POISONING.

It is usual with the galvanic current to try the effects produced by **transposition** of the **poles.** In **health,** the contraction produced by closure of the circuit by the negative pole is greater than that produced by closure of the circuit by the positive pole. In health, the effect of the faradic

current is more marked than that of the galvanic current in its contractive power over muscles. Dr. C. M. Haynes, of Chicago, remarks, in his work on electro-therapeutics, that when a muscle is deprived of its nerve influence, by poison or otherwise, leaving its fibres healthy, the reactions are very different from the physiological ones just described. He says, "The faradic will then produce no contraction of the muscle whatever, no matter how slowly the interruptions may be made. The influence of the galvanic current is increased, so that a weaker power is required to produce contractions than in the normal state. In this condition there is not only contraction at the instant of opening and closing the galvanic current, but, if the current be strong, there is often a tetanic spasm during its continued passage." This effect of a **tetanic spasm** during the uninterrupted passage of the current is entirely **abnormal.**

ELECTRO-DIAGNOSIS IN PARALYSIS.

Dr. Haynes' statement of the principles of electro-diagnosis in cases of paralysis is so clear and condensed that we reproduce it here :—

" Cases of paralysis giving **normal** electrical **reaction** usually indicate that the disease originates in the **brain** or white columns of the cord.

" Cases of paralysis giving **abnormal** electrical **reaction** usually indicate disease either of the **gray matter** of the **cord** or the **peripheral nerves.** The evidence is stronger if the electrical responses are changed in quality and character in addition to quantity and degree.

" **Paralysis** of one side of the body (hemiplegia) is usually due to brain disease.

" Paralysis of the lower half of the body, including the bladder and rectum (paraplegia) is generally due to spinal disease.

" Cross-paralysis, where the loss of power is irregular, as when it affects the face on one side and a limb on the other (hemiplegia alternate), may be dependent on disease of the brain or the **white columns of the cord.**

" The **reaction** in **hemiplegia alternate** is normal; therefore the disease cannot be exactly located by electricity, but must be determined by general symptoms,—often a matter of great difficulty. Fortunately, the latter form is extremely rare.

" When electrical reaction is **greatly increased,** it indicates hyper-excitability of the nervous system; and when, in addition, reflex muscular contractions are produced in various parts of the body by stimulation of a nerve in the paralyzed parts, it is further evidence of great irritability of the spinal cord, almost, if not quite, amounting to organic disease. When paralysis is confined to the branches, and muscles supplied by a single nerve-trunk, the probability is that the lesion is of **peripheral origin.**

"When a limb has lost its power of motion as a result of disease of the cord, the **abnormal electrical responses** may exist in one of three ways.

"They may be **uniformly distributed** throughout the entire paralyzed member, all the muscles being equally affected. This takes place in **gross lesions,** involving a mass of the structure of the cord.

"They may be distributed only to certain muscles forming **physiological groups,** irrespective of the nerve supply. For example, all the flexors of a limb, or its extensors, may present abnormal reactions, although they receive their nutritive supply from different sources. This occurs in chronic affections of the anterior roots of the spinal nerves.

"They may be **irregularly** distributed, affecting muscles neither in anatomical nor physiological groups. This often follows **acute inflammation** of the gray matter.

"They are always distributed according to **anatomical relations** in peripheral paralysis; in other words, the abnormal reactions occur only in those structures which receive their nerve supply from a special nerve-trunk totally irrespective of their function.

"Hence, **limited paralysis,** originating in the **cord,** may be distinguished from that originating in a **peripheral nerve** lesion, since in the former the limb is uniformly affected, or its muscles are attacked in physiological or irregular groups, while in the latter they are affected according to their anatomical distribution.

"PARALYSIS ARISING FROM DISEASE OF THE GRAY MATTER OF THE CORD.

"When the **abnormal reactions** are **uniform,** extending over an entire limb, the disease occupies a mass of its substance, as in the inflammation of the substance of the brain (myelitis).

"If they are **confined** to certain physiological **groups** of muscles, the disease has generally been chronic, and implicates the anterior roots of the spinal nerves, as in progressive muscular atrophy.

"If the degenerate muscles react in an **irregular** manner, neither according to distribution nor function, the disease has usually been the result of an acute inflammation of the anterior cornua, which has destroyed some of the nutritive centres and left others intact.

"When a **nerve** is found **deficient** in response, and **muscle normal,** it shows alteration in the former, the latter remaining intact, as is sometimes seen in the early stage of infantile paralysis.

"The electrical reactions in **peripheral paralysis** indicate with exactitude the extent and distribution of the disease.

"When the electrical reactions are **normal** it indicates a paralysis of slight and temporary form; prognosis is favorable.

"**Loss** of **response** when either current is applied to nerve-trunks points to nerve-alteration, and this in proportion to diminution of action.

"Loss of response to **faradism** applied direct to a muscle indicates changes in the intramuscular nerves, without necessary alteration of the fibres themselves.

"Loss of response with **galvanism** applied to the muscles shows a modification or destruction of the muscular tissue, and this in proportion to the physical changes induced.

"REACTION OF DEGENERATION.

"Immediately after a muscle has been injured severely enough to destroy a portion of a motor or mixed nerve, it has been found by Erb that atrophy of the muscular fibres sets in, which may be seen during the second week, and reaches its limit about the fifth or sixth week. At first it ceases to respond to the faradic current, then follows a period when it will act only to a slowly interrupted galvanic current, and finally ceases to react to any form of electrical stimulation; he termed this the reaction of degeneration. It is **present in paralyses** arising from rheumatism, lead palsy, the paralysis peculiar to writers, telegraph operators, etc. In those difficult cases after railway and other accidents, when persons demand compensation for damages, the existence of the reaction of degeneration would be a fact of **vital importance** in favor of the applicant, as it would indicate that he was suffering from a serious injury of the nerves. Such a demonstration in a court of justice is more conclusive than any amount of authoritative opinion."

STUDY OF THE MOTOR POINTS OF MUSCLES.

It would require pages that we have not at our disposal to enable us to present drawings of the nude human figure represented in different positions, with the motor points marked upon them, with the addition of accompanying descriptive text. This matter, which will be found in the more voluminous works on electro-therapeutics, the drawings in the work of Erb being particularly fine, is instructive, and yet there is only one unroyal road to full acquaintance with testing for reaction and for exercise of muscles, and that is to practice upon one's own person and elsewhere the physiological reactions of muscle, and carefully compare with them, when opportunity serves, the reactions afforded by the pathological conditions which will continually offer themselves to observation. Every one who reads these pages is justly presumed to possess enough anatomical knowledge to serve as at least a basis for any physiological experiments and pathological observations which he may desire to make.

Without this kind of study of the subject, on the living body, he might study motor points from prints and descriptive text until doomsday without becoming an expert electro-therapeutist. As well might one expect to be a skillful surgeon without having made even a dissection.

CENTRAL GALVANIZATION.

With the mature judgment derived from long experience, such as that of Drs. Beard and Rockwell, supplemented by such skillful manipulation as theirs, central galvanization, of which they were the originators, may be a perfectly safe procedure. But, even according to their own adverse, as well as favorable, showing, to which we could add testimony in the same direction, it is evidently one which had better be scrupulously avoided by the averagé operator. The **object** of **central galvanization** is, to use Drs. Beard and Rockwell's own words, "to bring the whole central nervous system,—the brain, sympathetic, and spinal cord,—as well as the pneumogastric and depressor nerves, under the influence of the galvanic current. One pole (usually the negative) is placed at the epigastrium, while the other is passed over the forehead and top of the head, by the inner borders of the sterno-cleido-mastoid muscles, from the mastoid fossa to the sternum, at the nape of the neck, and down the entire length of the spine."

Their procedure consists in passing the positive electrode from one side of the forehead to the other, rarely over the head, and then to let it remain for a minute or so on the cranial centre. In this procedure from two to six cells are generally used, the current being brought up from a weak one and increased until a sour or metallic taste is perceived. They regard the **cranial centre** as the most important region of the head in all electrical applications, a current passing from that point to the epigastrium traversing the roots of the facial nerves and affecting the sympathetic. Sudden interruptions of the current may, under the circumstances described, cause dizziness. During from one to five minutes the positive electrode is passed on both sides down along the inner border of the sterno-cleido-mastoid muscle, from the auriculo-maxillary fossa to the clavicle, thus affecting the pneumogastric and sympathetic. Proceeding to the spine, especial attention is paid to the cilio-spinal centre, below the first and seventh cervical vertebræ. Thus, the cervical sympathetic and pneumogastric, as well as the cord, are influenced by the current. The positive pole is also passed up and down over the whole length of the spine.

Drs. Beard and Rockwell remark that, as the back is not usually sensitive to the current, it may be treated during from three to six minutes, the whole **length** of the **sitting** for central galvanization requir-

ing only from five to fifteen minutes. The disrobing required of the male patient is the removal of coat and waistcoat and the loosening of the collar, so that free access can be had to the epigastrium and the spine, while, for the female patient, it is necessary to remove the corsets and loosen the clothing at neck and waist, so as to afford access to the same parts. The **electrodes used** for central galvanization by Drs. Beard and Rockwell are, for the **negative** pole at the epigastrium, a sponge or flannel-covered electrode of broad surface, having an insulated handle that can be held by the patient. For the **positive** pole they use flannel-covered electrodes, the disks of which are parallel with the handle, so as to permit of their being easily passed up and down the spine under the clothing. The battery should be one of constant current, and furnished with a rheostat.

The methods of application could not be other than they are from the anatomical point of view. The question is not as to them unequivocally, but as to them from two other points of view: First, as to whether the procedure in itself does not entail too much risk for any object to be gained; and, second, if it does not, in the skillful hands of Drs. Beard and Rockwell, entail such risk, whether it is one to be attempted by the ordinary medical practitioner. Drs. Beard and Rockwell themselves quote weighty authority **against the procedure** from men who cannot be considered inexpert.

They state that, so far as Althaus had experimentally carried out their method, by applications to the head and neck with the positive pole, and to the epigastrium with the negative pole, he had produced disagreeable cerebral symptoms, sometimes lasting for twenty-four hours after the operation. "The patient," said Dr. Althaus, "had a general sensation of malaise and nervousness, headache, and a feeling of giddiness and confusion." He added to this, however, that he had with advantage applied the positive pole to the cervical and lumbar spine and the negative pole to the epigastrium.

Dr. Anstie, Drs. Beard and Rockwell themselves say, speaks of galvanization of the **cervical sympathetic** as a method either to be **avoided** or to be used with great caution; and, in support of his opinion, he cites a case from his own practice, and repeats, in his review of Tibbetts's "Hand-Book of Medical Electricity," the same **caution** as to the procedure. Dr. Brown-Séquard, too, quoted by Drs. Beard and Rockwell, remarks that he once tried to galvanize the cervical sympathetic of a friend of his, to try to relieve him of a violent headache. "The effect," remarked Dr. Brown-Séquard, "was all we could desire against the headache, but the galvanic current, acting at the same time on the sympathetic and the agus the simultaneous excitation of these two nerves cannot

be avoided), produced such a dangerous syncope that I would never try again to apply galvanism to the cervical sympathetic of man."

Drs. Beard and Rockwell answer the objectors in detail and in general. But, that there should be such objectors to the procedure described justifies us in all that we have expressed in the way of doubt. "These men be masters in Israel." If, then, they have found a certain procedure in their hands disagreeable, and sometimes dangerous, it behooves all lesser men not to undertake it until they can justly deem themselves equally competent with Drs. Beard and Rockwell to venture it. The heart receives nerves from the vagus or pneumogastric nerve and from the spinal cord, through the sympathetic nerve. When the vagus is stimulated, currents pass along it to some of the ganglia of the heart, and inhibit its action, producing slower beats or an entire arrest of function. Fibres which, on the contrary, accelerate the action of the heart, derived from the cervical spinal cord through the last cervical and first thoracic ganglia of the sympathetic, stimulate its centres. These, which are called accelerator nerves, increase the rate but weaken the action of the heart. Take it for all in all, we prefer, therefore, to rest where we began, with the admission that while, in most experienced and skillful hands, central galvanization may be at times a proper procedure, it is by no means to be attempted by any one who has not made a long and exhaustive study of the galvanic current and its application in electro-therapeutics.

STRENGTH OF THE GALVANIC AND FARADIC CURRENTS COMPARED.

Although the **difference** of **potential** is enormously greater in the medical faradic apparatus, as compared with that of the medical galvanic apparatus, as, indeed, we may add, it is enormously greater in any electro-magnetic apparatus as compared with the galvanic apparatus, yet, as the quantity of electricity is extremely small in the medical faradic apparatus, as compared with the galvanic, the mechanical action of the ordinary galvanic current is very much more powerful than that of the faradic current, although not so apparently. Because a faradic current may cause a muscle to twitch, palpitate, or violently heave, where the galvanic current may fail to make it do so, that is no proof that the **dynamic** effect of the galvanic current is not **vastly greater.** The mere tickling of a nerve on the face, and notably on the sole of the foot, may cause great muscular action, but no one would claim for the active cause of the movement much dynamic action. The fact is, as is well known, that **faradization,** as compared with **galvanization,** greatly excites the motor and sensory nerves, especially the nerves of the skin, but its **dynamic** effects are not

so deep-seated as those from galvanization. This is not, as some persons have thought, because it does not penetrate so deeply as the galvanic current, for it passes just as easily as the galvanic current through the whole body, but because the **quantity** of electricity generated by the faradic apparatus is, when dispersed in the various circuits in passing through the body, so **minute** as to be, as it were, lost in the mass of the body. Hence we find that the galvanic current is better than the faradic for establishing innervation and nutrition. Moreover, as the faradic current in the medical apparatus is constantly **reversing** its **polarity**, we have with it, as compared with the galvanic, no **persistence of dynamic effect**, be it much or little, in any determinate direction.

DETAILS FOR USING THE CURRENTS FOR DIAGNOSIS AND TREATMENT IN PARALYSIS.

Through the fact of its constant change, and its rapid sequence of change in polarity, there are many cases when the tendency of muscle to **reaction** is too slight to be controlled by the current from the ordinary **faradic apparatus,** and therefore its current must be **slowly interrupted;** and, again, there are other cases when the faradic current is even in this manner incapable of causing reaction, and must be superseded by the **galvanic interrupted current**, and then, after the galvanic current has established reaction, the faradic current may control the same reaction. As, in general, the faradic current produces contractions more readily than the galvanic current does, the only **rational explanation** of the difference discussed is, that it is owing to the greater quantity of electricity conveyed by the galvanic current that we must chiefly ascribe its superiority over the faradic current in improving innervation and nutrition.

COMBINED GALVANIC AND FARADIC APPARATUS.

Only a few years ago the medical apparatus which professed to give the facility of using both currents simultaneously was really represented by two different machines in the same receptacle. To some, but not to the same, degree this is still the case. At present, with an arrangement by means of which the poles of a faradic apparatus can be connected with those of a galvanic apparatus, the **two currents** can be **administered simultaneously** from what can, more properly than before, be regarded as the same apparatus. The galvanic battery has its cells, and faradic battery its small cells. No attachments or detachments are required to accomplish the purpose in view, of administering the galvanic alone, or the faradic alone, or the two currents together. By means of an admirably contrived switch, which is called a **current-**

selector, we have an easily managed agent for the selection of the currents. Pushed over to the extreme right, the switch gives one kind of current only; pushed to the left, it gives the other current only; pushed to the middle of the plate, it gives both currents. If the physician purposing to become an electro-therapeutist will add to the apparatus, of which the appliance just described is a part, an electrometer milliampèremeter and the Massey graphite current-controller, he will have, with the proper assortment of electrodes, adjustable and other, an excellent armamentarium. There are many inherent objections to the water-rheostats; and rheostats of the plug system, for adding to and subtracting from resistances, although well adapted to many purposes, are not at all suited to medical practice, and are, besides, enormously expensive when they are fine. The Massey graphite current-controller * gives a ready means of increasing and decreasing the galvanic current by the nicest and most insensible gradations.

TREATMENT OF PARALYSIS.

Having given the clear and condensed electrical diagnostic tests of Dr. Haynes for the various paralyses, his equally excellent general remarks as to procedures in the treatment of paralysis would here make so admirable a pendant to the former statement, that we cannot omit it at this opening of a brief presentment of special applications of the galvanic and faradic currents:—

"Galvanism is indicated in those cases in which we wish to excite the nerves of the skin, to destroy the outer skin or mucous membrane, to produce an increase of warmth, to produce a chemical process, and also blood coagulation.

"In certain peripheric paralyses in which faradism fails, galvanism, probably in consequence of its uninterrupted duration, produces effects which cannot be brought about by the necessarily rapidly-interrupted faradic current.

"When a muscle has lost all power of responding to the stimulus of a faradic current, in many cases its sensitiveness may be restored by the application of a tolerably strong galvanic current.

"Faradism is indicated where we wish to excite either the motor or sensory nerves, to produce contractions of the blood or lymphatic vessels, to affect certain organs supplied by the sympathetic nerve. To increase the volume of a muscle: This it accomplishes through exciting muscular contraction, which increases the temperature and at the same time improves its nutrition. To relax a tense muscle, or to loosen a

* The plumbago current-controller is the invention of, and was patented by, Dr. John Butler, author of "Electro-Therapeutics and Electro-Surgery." Philadelphia, 1879 and 1882.

peripheric contractor, single shocks from a strong faradic current are generally more useful than the galvanic.

"Galvanism not only acts as a powerful stimulant to nerves and muscles, when interrupted, but during the time it is passing without interruption it produces a marked alteration in the nutrition. To this effect Remak gave the name, **catalytic action.**

"When paralyzed muscles exhibit the **reaction of degeneration,** they are more sensitive to galvanism than faradism, therefore the former should be selected to improve their nutrition.

"With this exception, faradism is a more powerful agent in the direct treatment of paralyzed muscles than galvanism.

"According to Dr. Rockwell, in **paralysis** of **one side** of the body, when the muscles contract more readily under the influence of electricity than in health, electricity, if used at all, should be in the form of a very mild **faradic** current; even though the muscular contractions are not excited quite so readily as in a normal condition, the faradic is still to be preferred. On the contrary, when the contractility of the muscles is very greatly diminished, the **galvanic** current is indicated, the faradic current being only employed after the muscles begin to contract under its influence. In most cases of paralysis of the lower half of the body there will be found, after a short time, more or less complete loss of farado-muscular contractility; the galvanic current alone is useful in these cases to restore nerve excitability, although the faradic may be usefully employed to improve the impaired nutrition of the paralyzed members."

CLINICAL CASES IN OUR EXPERIENCE.

A late clinical case was that of a man who, although seeming in passably good health, gradually lost the use of one of his arms, to the extent that he was no longer able to perform his accustomed work. The history of the case included mention of a blow on the shoulder received long previously. This suggested **nerve injury,** despite the fact of the length of time intervening between the blow and the paralytic affection, and despite also of the fact of the good muscular development observed in the case. Although the disease was chronic, the electrical reactions to both galvanism and faradism were normal, not only throughout the sound part of the body, but through the paralyzed member. Hence the lesion was inferred to be, not **spinal** but **cephalic,** and the subsequent autopsy confirmed the diagnosis. Another case presented symptoms very similar to those just described, but with this difference, that the paralysis had made more rapid progress than in the first instance, and it was also associated with some atrophy of muscle. Here, as in the first case, the reaction to both the currents was normal, and peripheral lesion

was therefore absent; but, on the other hand, atrophy of muscle becoming pronounced on both sides, the disorder was decided to be **spinal**, and this diagnosis was also confirmed by autopsy. In these cases the employment of the currents cannot be said to have directly decided the character of the affections in each case, but to have indirectly contributed to the conclusion reached.

A man found one of his arms painful after a fall, and soon experienced numbness in the fingers, associated with weakness of the whole limb. The part exhibited no muscular atrophy, but he experienced pain all around the ulnar nerve. Testing with the currents for reactions, only some of the nerves and muscles on the injured arm responded, while on the other arm they all responded. The lesion was therefore decided to be **peripheral**, and the prompt recovery under appropriate treatment established the correctness in diagnosis.

Here, in this connection, a cautionary word will be well. In **diagnosing** with the currents it is necessary to avoid stronger currents than will barely effect the end in view. If violent contractions are superinduced by the currents, the enfeebled **reactive force** of the parts may be obliterated. It is best to proceed with the greatest care, by **gently nurturing**, as it were, the contractile force, until it is built up to a point when stronger currents can be used in treating the parts.

The tremor of **chorea** and **allied tremors** are often relieved by general galvanization. The frequently observed twitching of the muscle, common raiser of the upper lip and the alæ of the nose, is readily relieved by local faradization, as is also twitching of the eyelids by the same treatment.

In **neuralgia** we can often decide whether the pain is purely neuralgic, or a hysterical,—pseudo-neuralgia, by the circumstance that pure neuralgia yields to galvanization, while pseudo-neuralgia is amenable only to faradization.

Treatment with the currents is quite efficacious in **rheumatism.** They should be used generally and locally,—as **constitutional** and as **local** treatment.* In employing them *in loco morbi*, care must be taken not to use them too strong nor too long. The very thing which, properly employed, may soothe, allay, or dissipate inflammation, may be made to exacerbate and increase it. We are satisfied that, over a large range of the field of electro-therapeutics, **mild administrations** are the most beneficial. If a skilled masseur comes to treat a sprained ankle, or to rub a rheumatic limb, he does not use brute force or keep up even a small force for a great length of time. Lose not sight of the fact that the currents are force, that they are agitating parts, not only as masses, but as to

* "The Therapeutic Uses of Electricity," by John V. Shoemaker, A.M., M.D. Journal of the American Medical Association, 1889.

their intimate constitution, and that this passive exercise may be made the hardest kind of exercise, and the most disastrous, if too violent and too much prolonged. Just as a weak person may be tickled to death, or come within an ace of it, so a weak person may be passively exercised with such exercise as the electric currents can inflict, to the degree that every nerve and muscle where it has passed, instead of being refreshed and invigorated, shall have lost tone, and be in the depth of lassitude.

DIFFERENTIAL EFFECTS OF THE GALVANIC CURRENT IN RHEUMATIC AND GOUTY AFFECTIONS.

The experience of Drs. Beard and Rockwell, which probably covers a wider field than that of any other two electro-therapeutists in the United States, is that chronic **articular rheumatism** is, of all forms of rheumatism, the least amenable to electrical treatment, and that the best effects from it are obtainable in the regular gradation, of the muscular form, the acute, and the subacute. These same authors note that, in the case of **chronic gout,** temporary relief may be obtained from both faradization and galvanization of the affected parts, but that galvanization of the joints seems to have very little catalytic effect. They remark that, in rheumatic gout, the same deficiency of catalytic effect from the galvanic current is observable, that there is no marked success from both of the currents when administered in this disease with reference to toning the general trophic system,—that, in fact, the disease is very intractable to electrical treatment.

Certain neuralgias are quite amenable to the constant current. In a case which we have in mind, when the whole array of antiperiodics and narcotics had been tried, the patient, a lady, was treated as follows with the galvanic current. The positive pole was applied to the shoulder (stabile) and the negative to the arm, forearm, and hand (labile), with a current beginning with five milliampères, and increased to sixty milliampères. This treatment, daily, effected a perfect cure, although she had suffered from cervico-brachial pain for four years; and she remains well now, although three years have elapsed since the operation.

FACIAL NEURALGIA CURED BY GALVANIZATION.

A washerwoman suffered from a severe facial pain, involving, on one side of the face, the temple, eye, and cheek. The patient, being constipated, having little appetite, and suffering from nausea at times, had been successively treated by various physicians for liver and stomach complaint, disease of the kidneys, dyspepsia, for disorder of the womb and ovaries, but all without avail. Pressure over the focal points causing relief rather than pain, **faradization** was employed in this case. A moderate

current was made to pass through the tender parts of the face to the nape of the neck. Twenty-five administrations effected permanent relief.

GENERAL FARADIZATION AND LOCAL GALVANIZATION IN HYSTERIA FROM SPECIAL IRRITABILITY.

Alternation of general faradization with localized galvanization of the spine is wonderfully efficacious in forms of **hysteria** from spinal irritability. Many nervous girls whose condition from this cause lessens their own enjoyment of life and that of every one around them have had beneficial change wrought in them through this new therapeutic treatment. Many physicians are too prone to assume the existence of uterine disorder, and the necessity of abdominal surgery, on occasions when an electrical treatment like that described is all that the symptoms indicate for a case of hysteria in the female.

Any one who has ever seen, as we have, the skillful manipulation of a professional rubber of sprains, who is usually believed by the ignorant to have magic in his touch, can realize how well adapted the **electrical hand** must be for the same purpose, the rubbing hand itself conveying the current. Both currents can be used in treating sprains, the sensations of the patient being an excellent guide as to which should be continued, and as to the strength of the current, which should be in all cases mild. A part near the surface, such as a finger-joint, may be so severely attacked by the current as to experience acute pain; and it is not conceivable that an administration of the current, coupled with this effect, is accomplishing good.

A PLEASURABLE AS WELL AS USEFUL MODE OF ADMINISTERING THE FARADIC CURRENT.

This last observation of ours leads us to remark that the **faradic current,** which produces on the dry skin a sensation which, even if not painful, is far from pleasant to most persons, can be so used as to be productive of the most **agreeable sensations.** If there is any necessity for a patient, otherwise well, to treat himself for any affection, such as **constipation, enlarged prostate,** etc., he cannot do better than with a Gaiffe, or other small faradic apparatus, placed alongside of him on a stand about three feet high, to assume the ordinary recumbent position in a tepid bath, and then to use the electrodes upon any immersed part of his body to which he may wish to administer the current. He will find that the current, comparatively free to move through the wet skin, can be passed with fan-like wafts over his person, from one pole held at some distance from the body, and moving freely to and fro, while the other pole is held at some convenient indifferent spot on the body.

If the treatment is for the reduction of the prostate gland the one electrode, in the form of the ordinary brass tube with wooden handle, should be placed between the legs, on the **perinæum,** avoiding putting it so far back as to touch the mucous membrane around the anus, which it unpleasantly shocks, and then with the other electrode, masked with the usual sponge and placed on the symphysis pubis, he can administer the current to the part with the greatest ease and satisfaction.

If one wishes to promote **peristaltic** movement, so as to relieve **constipation,** a sponge-covered electrode is placed on some indifferent point of the body, and the other electrode, also armed with a sponge, is passed around the abdomen in the direction of the colon, circling from right to left by the upward path.

If, finally, one should wish to treat himself to a general faradization, to give himself an **electrical douche,** as it were, over the whole immersed part of the body, he will place one electrode on the inner part of the thigh or elsewhere, and, with the other electrode about an inch from the immersed part of the body, move it in every direction almost tangent to the skin, not forgetting to let the **genito-urinary organs** come in for their share of the treatment. Here especially, however, the treatment should not be strong or too long pursued. The effect of a moderate current, not too long continued, on the genito-urinary organs is at once recognizable as to its tonicity, both by the eye and the general sensations, but **prolonged treatment** of these delicate parts more than counteracts the healthful effect of their judicious treatment.

The diseases of the **female sexual organs** for which electrical treatment has proved beneficial are, according to Drs. Beard and Rockwell, amenorrhœa, dysmenorrhœa, menorrhagia, leucorrhœa, chronic pelvic cellulitis, uterine hyperplasia, subinvolution and superinvolution, atrophy of the uterus, displacement and prolapsus, ovarian neuralgia and ovaritis, peri-uterine hæmatocele, stenosis of the uterine canal, cystic growths, and fibroid and ovarian tumors.

TREATMENT OF CANCER BY ELECTRICITY.

Late experience of **electrolytic** treatment of **cancerous** growths leads to hopefulness that they may often prove amenable to electrical treatment. Dr. Parsons, of the Chelsea Hospital for Women, writing in the *British Medical Journal*, reports favorably as to progress in that direction. M. Darin also contributes to our knowledge of excellent results derived from that treatment in the case of **cancer and allied tumors.** Dr. Inglis-Parsons gives the following as his **method of procedure** in the electrolyzation of cancer :—

" The patient is anæsthetized ; the current is then passed through the

tumor and all the tissues for some distance round it by means of fine, insulated needles, so as not to injure the skin. A battery of seventy cells, with an electro-motive force of one hundred and five volts is used; the intensity of the current, to commence with, is ten milliampères, gradually increased to six hundred milliampères, and flashed through the growth in every direction from fifty to one hundred times, according to circumstances. The pulse and respiration were carefully watched. One out of the four cases treated, a woman, aged sixty-three, with extensive carcinoma of the left breast, a presystolic **bruit,** and weak, intermittent pulse, was unable to stand more than two hundred and fifty milliampères for this reason: when the current is applied to the left breast electrical stimulation of the heart occurs, and if this organ is healthy an increase in the strength of the contraction appears to take place after its passage; but with the patient, who had cardiac disease, the improvement only continued up to a certain point, and then the intermittency increased and great irregularity occurred. The current could be borne with safety when, at six hundred milliampères, it was passed through a secondary growth in the axilla of the same patient."

It is claimed for this treatment by Dr. Inglis-Parsons that it alleviates pain, arrests the growth, reduces the size of the tumor, and improves the general health.

Epilepsy and epileptiform affections are sometimes amenable to the influence of the **galvanic** current. The practice best approved in essaying this kind of treatment is to seek to anticipate a seizure and abort it; counting upon this, that if the allowance of time of anticipation has not been quite sufficient, at least the shortening the time of the seizure will be accomplished. The **method prescribed** for administration in this case is application of the positive pole to the vertex of the cranium, and of the negative pole to the epigastrium. In all cases where the head is concerned the current should be **descending.** The effects of the bromides are heightened by conjoined electrization. When minor epilepsy is evidently merely checked by bromine, electrization may make a cure such as it has in many cases effected in the hands of skillful practitioners.

Mild galvanization of the brain soon after paralytic seizure hastens the **absorption** of the effusion. From six to twelve weeks being allowed for absorption of the clot, local faradization of the affected muscles affords most satisfactory treatment. For **Bell's palsy** we employ localized **galvanization,** treating each affected muscle separately, and occasionally, when galvanization does not act curatively as quickly as anticipated, we employ the **franklinic spark** drawn from the muscles. There have been, by means of this treatment, recoveries so extraordinarily quick as to surprise even the patient.

In that disease which continues to baffle medical skill,—**locomotor ataxia,** for which suspension has lately been recommended,—much can sometimes be effected in the direction of palliating the suffering of the patient. The lancinating pains of the disease are sometimes relieved by galvanization. Spinal galvanization has sometimes effected even more for this disease, to the extent of so greatly ameliorating the condition of the patient as to permit him to go about, when previously he had been confined to a chair or bedridden.

The acute paroxysms of **sciatica** have been relieved by galvanization used by the method of the descending current; permanent cures have been obtained by **electro-puncture,** the needle being entered along one or two points on the painful portion of the nerve.

In all cases where **puncture** is concerned, where the action vehemently establishes **electrolysis,** through bringing one pole in contact with the moist tissues under the integument, we should carefully consider **which pole to employ.** Of course, there are operations where **both** of the poles must be embedded in the morbid tissue, but we are speaking of the cases where, in **unipolar operations,** there is a choice between them. Oxygen and the acids go to the positive pole, and hydrogen, alkalies, etc., to the negative pole. The **clot** which forms about the negative pole is yielding, that around the positive pole is hard, and hence the needle of the positive pole becomes firmly embedded. We have already sounded a **note of warning** against using the positive pole in the urethra, and now add in another direction to that information, which we will increase further on when we shall have occasion to speak of the **kind of needles** to be used in electro-therapeutic work. In treating by electrolysis a **fibroid tumor,** for example, we are aiming to disintegrate it. In consequence, we employ the **negative pole,** because, wherever the needle connected with it is inserted in the mass, marked liquefaction of the part is observed, which, by the way, we may presume to diminish indefinitely from all such points as centres. But if we are seeking to **arrest hæmorrhage,** while operating on a **myoma,** the needle of the positive pole should be used, because the polar action of the positive pole is coagulatory and therefore styptic.

That disorders such as **torpidity of the liver** and **constipation** should yield to faradization, that **indigestion, gastralgia, stomach-ache, pyrosis,** and the **nausea of pregnancy** should be amenable to galvanization is not at all surprising to any one who has reached with us the conclusion that **mild** electrical **currents** are tonic in their effects wherever they are made to pervade the human body for a proper duration of time. **Gastralgia** and **stomach-ache** are relieved by placing the positive pole on the cervical spine and the negative pole at the epigastrium.

TREATMENT OF STRICTURES OF THE URETHRA.

We cannot do better than invite the reader to look into the procedures of Dr. Newman, of New York, and Dr. Blackwood, of Philadelphia, for conclusive teaching as to **electrolytic** practice in strictures of the urethra. The rules as laid down by him are charming in their simplicity, including contra-indications as well as indications for the use of electricity in certain cases; but simple as the rules are they must, to be followed by success, be implicitly obeyed, since they are based on laws more immutable than were those of the Medes and Persians.

One of the methods of treating **prostatorrhœa** and **enlarged prostate,** besides that already mentioned, is that of reaching the prostate gland by an intra-rectal rheophore, representing the negative pole, while the positive—the indifferent—pole is placed on the patient's thigh or other convenient spot. In **extreme hypertrophy** of the gland the negative pole may be applied *per anum*, from three to five minutes, by means of a well-insulated needle, and with a current as high as it can be borne by the patient, the current-controller enabling the physician to submit the question of amount of current continuously to his patient. We are satisfied that in such cases it would often be judicious for the physician, if he has for his patient a person of intelligence, to allow him to regulate the current for himself by means of the controller, to the ultimate point at which he can bear it with equanimity. With Dr. Massey's current-controller this can be effected with the most gentle gradations. The patient, thus controlling the **strength** of the **current** to a nicety, would leave no margin of uncertainty as to what can be properly borne. The physician oscillates between too much and too little, whereas the patient's judgment and touch would unite with the infallible guide of sensation and the confidence begotten of supreme control.

INDICATIONS FOR STATIC AND FARADIC ELECTRICITY.

Dr. Blackwood reports that at St. Mary's Hospital, Philadelphia, great relief has been afforded in cases of phthisis from the administration of both static and faradic electricity. **Night-sweats** are often checked for a week after the first administration, and pains in the chest are greatly alleviated. The improvement in **nutrition** evidenced the source of these ameliorations of condition.

Spasmodic asthma and **chronic bronchitis** have been much alleviated by faradization of the thorax. The gravity of the dyspnœa, in the case of the former, has been much lessened. In two cases of which we know the paroxysms of **angina pectoris** were aborted by prompt galvanization of the sympathetic nerve, in both cases the left side being selected for the administration of the current. In both cases relief followed much

more quickly than it would have occurred from inhalation of nitrite of amyl.

Hay fever has proved amenable in some cases to **galvanization.** The general belief that nothing but change of climate will relieve the patient suffering from this complaint has heretofore forbidden our reaching determinate conclusions regarding the efficacy of electricity in its treatment. Enough, however, is known of successful administrations of the current for its cure to warrant us in still further pursuing our investigations regarding the effect of the current upon it. In the treatment of this complaint the positive pole is placed directly under the angle of the inferior maxillary bone (on the pneumogastric), and the negative over the solar plexus. The **duration** of the treatment should be for about ten minutes, repeated three or four times a week, and with a moderate current. **Faradization** by the application of the poles respectively to the cervical spine and the pit of the stomach has sometimes been employed, but the excellence of this practice is by no means so well established as that of the other method.

General galvanization has good results to show in **marasmus** and in **general debility** without atrophy of muscle. Combined with faradization of the muscles, instituted for the purpose of exercising them within moderate bounds, the systemic treatment by general galvanization offers **excellent results.**

Incontinence of urine, which is obstinate to treatment by drugs, can be controlled by persistent galvanization. Dyspnœa following **whooping-cough, measles,** and **scarlet fever,** and the occasionally resultant aphonia, are amenable to treatment by the galvanic current, and in the case of **aphonia** the employment of static electricity is often effective. **Dropsy,** as the sequela of scarlatina, is sometimes quickly reduced by localized electrization. **Œdema,** in both children and adults, provided that Bright's disease is not a complication, is also at times reduced by localized electrization. In **diabetes** the excretion of urinary solids is promoted by local faradization of the kidneys, the volume of fluid not being increased, but, on the contrary, sometimes diminished. **Faradization,** which relieves hyperæmia of the mucous lining of the bladder and lessens the mucous discharge, often cures cases of **cystitis** in both children and adults.

The direct dependence of certain **cutaneous diseases** upon disturbance of the central trophic system leads us at once to expect from electricity, used both generally and locally, excellent results in the treatment of some of those affections.*

* "Electricity in Skin and Venereal Diseases," by John V. Shoemaker, A.M., M.D. The Medical Bulletin, October, 1889.

The **galvanic** current is used with markedly good effects in **chronic eczema.** There is probably no cutaneous disease which offers results so uniformly good from the employment of electricity as does eczema. Especially where eczema is complicated with, or seems to be largely determined by, **disorder** of the liver, the current is especially indicated. **Psoriasis,** too, seems to be a disease quite amenable to the electrical treatment. In the case of these diseases **central galvanization** with a mild current, with the precautions heretofore prescribed, should be instituted.

Many cases of **psoriasis** are unquestionably due to nervous depression. In these galvanization has the double advantage of being able to produce **systemic** and **local effects.**

In **erythema** and **erysipelas** mild galvanization removes the stasis, and, through absorption of the effusion beneath the skin, reduces the swelling. The extension of erysipelas is frequently checked by galvanization around the parts attacked, the positive pole being placed in the centre of the eruption, and the negative pole moved gently around beyond its circumference, the current, from five to ten milliampères, being so moderate as not to occasion muscular contraction.

In **herpes** simple or in **herpes zoster,** very mild, prolonged galvanization relieves the great prostration and the intense burning sensation. The formation of vesicles is checked, they are reduced in number, and the drying of those which remain is hastened.

In the inflammation caused in the skin from **poisoning** by the rhus toxicodendron and allied species, the galvanic current is very soothing and curative.

The itching, pain, and swelling of **pemphigus** are quickly relieved by faradization.

Discolorations of the skin, such as **lentigo, vitiligo,** and **rosacea,** are generally amenable to galvanic treatment. For **birth-marks, port-wine stains, varicella,** nothing proves more effective than the administration of the galvanic current. It is generally administered by sponge electrodes, while **galvano-puncture** is occasionally added for its cosmetic effects.

The relentless itching of **prurigo** is almost instantly relieved by local application of the faradic current. General and central galvanization produce upon it marked constitutional effect.

In **alopecia,** whether general or circumscribed, galvanization used as a stimulant to the hair, whenever the hair papillæ and follicles are not atrophied, has good effect in stimulating the parts and renewing the growth.

Faradization is very effective in **chilblains,** which, as is well known,

have a tendency to recur. Faradization allays the itching and burning and stimulates the skin to healthy action.

Urticaria, or **nettle-rash**, excites irrepressible desire to scratch, and hence, complicated with secondary symptoms, is sometimes an exceedingly troublesome disorder. **Galvanization** allays the itching, and in many cases has the effect of shortening the duration of the disease.

Galvanization is serviceable in **tinea versicolor**, which, although generally amenable to ordinary treatment, occasionally yields to it very reluctantly.

Administration of the currents has been found beneficial in the following **miscellaneous disorders.**

Coupled with entire abstention from penmanship, **writers' cramp** is deemed amenable to galvanization and faradization. This statement applies also to cognate disorders, of which writers' cramp may be considered the generic name. The treatment, when at its best for all of these, is **central** as well as **peripheral**, that practice obviously declaring that the lesion is not always to be regarded as strictly local. In view of the prevalence in these modern days of the distinctively writers' disorder, it seems extraordinary to us that every one who has much writing to do should not acquire the art of type-writing. Persistent practice for an hour a day for a month enables any one to write with tolerable ease, and thereafter he glides into such proficiency as to make the movements as automatic as those with the pen. The Remington, Caligraph, and Hammond are all admirable machines, the first two being especially adapted to the general writer's needs.

The aching in **hæmorrhoids**, or **piles**, attendant on the congestion of the parts, is often relieved by placing the positive pole of the galvanic current near the anus and the negative pole over the liver, and then passing a current of from twenty to thirty milliampères for fifteen minutes through the parts.

Instances of the dislodgment of **impacted gall-stones** by the use of the galvanic current have been reported by credible witnesses. However, whether or not we may be disposed to believe it, yet, as we have nothing which pretends to be able to meet this painful condition, and as, at the same time, the current is harmless, it would be well to essay through electricity the treatment of this disorder.

For the palliation and **breaking-up** of **intermittent fevers**, the use of both galvanization and faradization is indicated. In the practice of Dr. Blackwood, of Philadelphia, faradization is mostly used, but it is followed at the end of the sitting, in case there is glandular hypertrophy, by galvanization. In the galvanization, one pole is fixed over the solar plexus and the other over the liver, both before and behind, for five

minutes, and then for five minutes over the spleen. This is followed, for five minutes, by general faradization of the abdomen and spine.

The itching and swelling of the skin in **pemphigus** are a distressing phase of the disease, which **faradization** speedily relieves.

When, in **hæmatophilia,** drugs administered internally do not check the hæmorrhage, and exhaustion of the patient is liable to ensue, faradization is valuable on account of its effecting contraction of the capillaries.

Insomnia at bed-time is often successfully averted by general galvanization or faradization, which almost any kind of an attendant is capable of administering. They reduce febrile symptoms of an amount sufficient to render a patient restless, and to make sleep uncertain or uneasy. In the case when a narcotic is to be especially avoided, on account of its ill after-effects, we may find in electrization all that is needed to give tone requisite to insure refreshing sleep.

Boils and **carbuncles** may, if the suppurative process has not gone too far, be everted by galvanization.

The **needle operation** for **epilation,** in which the positive pole is held in the hand of the patient, and the needle forming the negative pole is embedded in the papilla of the root-sheath, and the galvanic current then turned on, by which means unsightly hairs are utterly destroyed, is one of such slight gravity that it taxes only the eyes and deftness of the hand of the operator, with ample reward for the slight endurance required of the patient.

Faradization, **alternated** with galvanization, and sometimes even combined with it, is coming into general use. Sometimes, although **galvanization** seems to be indicated, it fails to act as promptly as expected, and then, the active capillary stimulation of **faradization** being allowed to precede it, succeeding galvanization will be found to take full effect. What is true, as derived from experience, naturally suggests itself even to inexperience, that in most skin diseases in which **itching** is a prevalent and exasperating symptom, the faradic current alleviates it, from the fact of its peculiar dynamic action on the cuticle.

Operators cannot be too careful to insure the **cleanliness** of all the **instruments** with which they work. The electrodes used on a patient should be washed in water immediately afterward, to insure that they be not inadvertently employed in an improper condition on another patient. In addition, they should be rinsed off in a solution of **boric acid** or of **corrosive chloride of mercury.** Disregard of these precautions may be ruinous to both physician and patient, from the circumstance that the neglect of them may lead to contraction of a disease not contemplated in a treatment. It is to be impressed on the reader that cutaneous diseases are sometimes **contagious,** and that in **syphilitic disorders** the virus is so

subtle that it would be best in all such cases treated to burn the covers of the electrodes and replace them with new ones. Electrode coverings, when not of absorbent cotton, should be frequently replaced by new ones, both sponge and chamois-skin being objectionable.

PRECAUTIONS AGAINST ALARMING OR ANNOYING THE PATIENT WHILE ADMINISTERING ELECTRICITY.

The **mysteriousness** of electricity excites in the average patient a lively sense of alarm when the first administration of it is allowed. The knowledge of the physician that, under proper safeguards, it is perfectly safe, should not, however, cause him to lose sight of the fact that, if he permits some of the manifestations of which it is capable to present themselves, he will be sure unduly to alarm his patient, and seriously obstruct the end he has in view, even if he does not incur the penalty of obtaining from his patient a sitting for the first and last time. In all applications of the currents, for trifling ailments as well as for severe ones, comfort to the patient and success in the operation are not to be obtained with poor instruments and unskillful procedure. Batteries which are so contrived as to have cell-selectors, by which few or many cells are brought into circuit, are imperfect. The cells most used are, of course, soonest exhausted, and when the whole battery is put in action, its strength is limited by the exhausted cells. That renders the apparatus an inefficient instrument for all purposes to which one may wish to put it, and, such as it is, it is uneconomical. It is therefore the interest of the physician to have things different, and the interest of the patient lies side by side with that of the physician. If the cells used are few in number, the current is not constant, and pleasant reception of the current is inseparable from its constancy. There are enough **difficulties** in the way of making it perfectly constant to sensation, one, even the difficulty of making the very same poles convey with constancy, without introducing a purely gratuitous **element of inconstancy.** The only proper battery is one in which all the cells are simultaneously employed, whether the current needed be great or small, the draught upon them being equalized by a **current-controller.** Thus the **current** from the battery **remains constant,** and the patient is not annoyed by fluctuations. But there is a point far beyond mere current fluctuations from inconstancy of a battery which the operator must seek to avoid. If he uses a **commutator** on his galvanic battery, and a strong current is flowing, if he reverses the polarity of the current he will give a **shock.** It would have seemed **unnecessary** to mention this, but that it is understood among skillful electro-therapeutists that the fact of having a commutator on an instrument is often thought to indicate that it is to be used constantly in the administration

of the galvanic current. Now, the **reversal** of the current has its **specific uses** in galvanization; that is, the interrupted and the reversed currents are employed in galvanization, but they are not indiscriminately used; and the quantity and density of the galvanic current being far greater than in the faradic current, the interruption of it, or the reversal of it, might, depending upon its quantity and the part of the body through which it is passing, give a **dangerous** or even fatal **shock.** But, even in lesser degree, it is the physician's cue, in using electrical treatment, never to disturb, if possible to avoid it, the equanimity of a patient.

HINTS FOR CONVENIENCE OF TRANSPORTING BATTERIES.

Secondary batteries, or, as they are now popularly called, **storage batteries,** although they are not the wondrous receptacles of energy generally believed, are still admirable contrivances for many practical purposes. Nothing can be easier now than to utilize them when electrical treatment necessitates the carriage of the apparatus for treatment to the house of the patient. The difficulties are not, however, weighty in the matter of the transportation of an ordinary small galvanic battery if the physician will only carry the exciting fluid for it in a demijohn of convenient shape and size. With the addition of a funnel it is a matter of only a minute's task to put the battery in working order.

ELECTRO-SURGICAL PROCEDURES.

Heretofore we have treated of operative procedures which, excepting those to which brief reference was made in the case of mention of the extirpation of myomata and fibroids, almost any well-educated physician might attempt with propriety without previous clinical instruction. But now, in coming to the department of **electro-surgery,** it must be observed that many operations in it are of such severity and magnitude that no one should attempt them without having seen them performed by some operator of recognized skill in his specialty. In Apostoli's operations it is not mainly because the currents which he uses are so large—which circumstance alone seems to strike the medical imagination—that the operations are critical, but because they are in themselves critical, no matter what may be the manner of approaching them. So critical are they that no one, without having thoroughly mastered the manipulation, including knowledge of battery paraphernalia, should think of employing such electro-surgical procedures. The explanation of the endurance of the large currents administered by Apostoli is very simple. Employing, as he does, for the indifferent electrode a large disk of lead superposed on a still larger layer of moist potters' clay, and for the other electrode a cutting or perforating instrument of platinum, or needles, the current

passes through the body in what may be roughly regarded as a **cone of dispersal** with a very large base and a very small vertex. This is only saying, in other words, that the density of the eurrent is thereby lessened in its passage through the body, and that, where it is efficient at the operating instrument or instruments in the function of generating heat, it has, by the **law** of **electrical conduction** in metals, and by that, also, of the particular metal employed, its activity as electricity lowered, not in kind, but in degree, for instead of having electricity pure and simple we have electricity and heat.

DIFFERENCE IN ELECTROLYTIC CAPACITY BETWEEN VASCULAR AND FIBROID TUMORS.

It has been thoroughly established that, for electrolyzation, those **tumors** which are **rich in fluids** as compared with those which are not are less intraetable to electrical treatment by the galvanie eurrent. This, it was known, would prove to be the ease even before the beginning of medical treatment by the galvanic eurrent, for, to be an electrolyte, matter, it was known, must be in a fluid condition. In eonsequenee of the small amount of fluid in **fibroids,** they, therefore, **resist electrolyzation** more than any other kind of tumor. Shrinkage and atrophy ean often be prodneed, but often nothing beyond. In this treatment both needles conneeted with the poles are inserted in the tumor.

Sir Spencer Wells reports unfavorably as to the eleetrical treatment of **ovarian tumors** as compared with **ovariotomy.** The **percentage of cures** from the former he states as only 55 per cent., as compared with those from the latter,—70 to 80 per eent.

The reported excellent results from the treatment of benign **cystic tumors** are numerons. Beard and Rockwell recommend keeping the positive needle fixed in position and working the negative needle around so that it may act on the inner surface of the cyst, and also enlarge the hole made by it, so as to permit the inclosed fluid or gases to escape.

Nævi can be suecessfully treated by the eleetrolytie method with a mild current. Anæsthesia, either general or local, depending upon the character of the ease, should be adopted. When an indifferent pole is used, make it of a moist-sponge electrode, stationed near by on a sound portion of the skin, and for the other pole use one or more needles. The **current** required is a moderate one, and its **duration** should be from five to fifteen minutes, depending upon the size and character of the nævus. Nice judgment is required in the operator as to the strength and duration of the current, espeeially when, the treatment being on the face, cicatrization is particnlarly to be avoided.

For ordinary **aneurism** the treatment is with an indifferent pole,

using the positive pole at the point of operation, or by both poles, at the the seat of the lesion. The needles are insulated nearly to the tips, so as to prevent the current from acting on the walls of the aneurism. For aneurism **near the heart** no one should presume to operate unless thoroughly conversant with the whole procedure. An anæsthetic spray precedes the operation. The current-controller should always be in circuit, to prevent all possibility of shock. Some physicians have condemned this operation under any circumstances. Others reply that there are occasions when, any other procedure being impossible, this affords at least a forlorn hope.

Dr. Semmola, as quoted by Dr. Haynes, suggests that electrolyzation cures **malignant tumors** in one of the three following ways:—

"By producing small foci of inflammation with consecutive sclerosis, the tumor being converted into a small, indurated, and harmless lump; by producing a colloid and fatty degeneration, especially in tumors with this tendency; and by exciting destructive inflammation and suppuration of the tumor. Along with this treatment he has combined the administration of large doses of iodide of potassium, with a view of gravely modifying the general nutrition."

The **needles used** for electrolyzation should always be either of **gold** or be **gilded,** unless occasion should arise to make it desirable to introduce some metallic compounds into a part through the peculiar action of the positive **pole,** in which case, of course, the needle for the positive pole should be made of the metal desired for dissolution.

The platinum galvano-cautery loop is used for the same purpose as the **écraseur** is adapted to, being principally applicable to pediculated tumors, and having the advantage over the écraseur of stopping flow of blood by cauterizing while it severs the tissues. The instruments for galvano-cautery and galvano-puncture are the platinum points, platinum knife (a slender blade which burns instead of cutting its way), and the platinum dome (a surface for cauterizing). Platinum is the metal used, because, while the metal is otherwise well adapted to these instruments, its resistance to the galvanic current is so high as readily to allow it, in such small masses as those which represent the instruments, to be brought to a red or a white heat by the power of a suitable battery.

FRANKLINIC ELECTRICITY.

It was long ago proved that **static,** or **franklinic,** electricity, when in equilibrium, resides on the outside surfaces of conducting bodies. When on a sphere of metal the electricity is equally distributed outside. When on an ellipsoid of revolution the density of the electricity is greatest at the ends of the major axis. And yet it would be going too

far to assume that static electricity in a condition of equilibrium resides entirely on the outside of conducting bodies. The supposition negatives the postulate that the bodies are conducting upon whose outsides it is supposed to reside. How can we leave out of consideration the fact of the bodies being conducting, when static electricity has preference for conducting bodies? If it has, and it has, a preference for conducting bodies, does not that prove that all of the electricity does not reside on the outside of them, and that the safer statement regarding the behavior referred to would be that static electricity in equilibrium **tends** to reside on the surface of conducting bodies? As we can never examine the interior of solid conducting bodies, this question is not open to experimentation, but it seems to us clearly determinable by the considerations just set forth.

In a **general way,** however, we must consider the fact, broadly stated, to be true, that static electricity in a condition of equilibrium resides on the outside of conducting bodies. Only on two conditions will it sensibly remain on the inside of a conducting body, and they are when the body is hollow, and when, at the same time, an electrified body is suspended within, but without contact with, the inclosing body. Many were the tests by Coulomb and others, which established this fact, none, perhaps, so striking as one by Faraday, who had a cubical box constructed, twelve feet on a side, covered with tin-foil and copper wire, and insulated from the earth. Yet, although this box was electrically charged from the outside by a powerful machine, a gold-leaf electroscope and every other electrical testing device could detect no electric charge whatever within the inclosure, although outside it was giving off a profusion of sparks and electric brushes.

DOES STATIC ELECTRICITY PASS THROUGH THE BODY?

The human body is a conductor, although a poor one. It is certainly far from being a non-conductor, as we have proved by passing through it the galvanic and faradic currents. As there is reason to believe that static electricity, even in a condition of equilibrium, permeates below the surface of a conducting body, there is ground for believing that the electricity communicated by the static electrical machine is a current passing through, as well as on, the surface of the human body. It would be difficult, although not impossible, to settle this question experimentally, but, in the meantime. as no attempt has yet been made to settle it by experiment, we may be permitted to discuss the probability upon general principles.

We might say, in the first place, that the **electro-therapeutic** effects of static electricity would not be so **manifest** as they are, if the admin-

istration of static electricity (putting the spark out of question, for then it becomes dynamic) resulted in a mere coating of electricity on, or a gliding of electricity off, the skin. But, as static electricity has not yet, excepting as to its spark manifestation, obtained widespread faith as to its therapeutic value, we must discard that statement by way of argument. Of course the **sensation** in the skin from the disruptive discharge affords **no argument** as to the electricity being more than superficial on the body. The electricity of the Leyden jar also resides in an altogether superficial manner on the tin-foil coatings. We must, therefore, go further back in the consideration, even to fundamental facts.

It is a fundamental fact that static electricity, so called, resides at east chiefly on the surface of bodies, when it is in a condition of equilibrium. But is it in equilibrium when the apparatus to generate it and administer it is engaged in the process of destroying its equilibrium while increasing its potential? The apparatus generating the electricity must be kept in motion, because the electricity is passing away, partly into the air, through convection or conduction, or both, and partly on the person (we will not beg the question by saying *in* the person) of the patient under treatment. Assuredly it is not in equilibrium then, even if we concede that it may be only flowing over the outside of the patient's body.

But when, further, we consider the ease with which mere touch in electricity communicates charge, and additionally, the complexity of the human structure, internal more than external, different internal parts being differently susceptible to electrification, as has been proved by experiment upon various parts of the dissected lower animals, it does not seem **reasonable to suppose** that the condition of being charged with static electricity represents anything less than a streaming of electricity through various media susceptible of various charges, but all tending to flow off at the general surface of the inclosing organism. That, **normally,** the body is slightly charged with electricity, and that its states of electrical charge are modified by temperament, health, fatigue, and other conditions, seems to be established. If this be accepted as true, it is incredible that the body is not susceptible of having those states changed, or at least temporarily modified, by outward influence directed to the purpose by mechanical means. And if these states are susceptible of change through artificial means of producing it, that probably means flow of electricity from a static condition within the body, for it is inconceivable that anything reconcilable with the idea of electrical states could be represented only on the surface of the body by the presence of electricity, such presence being elsewhere, under apparently analogous conditions, quite evanescent.

MACHINE FOR GENERATING STATIC ELECTRICITY.

The old frictional machine for generating static electricity is now discarded, and instead of it is used, as by far the most convenient machine for its generation, one of the modifications of the induction machines of **Holtz's invention.** This has undergone many modifications. Poggendorff and Ruhmkorff made changes in it, and one of the machines which seems now to meet very general approbation is of the variety known as the Toepler-Holtz. This type of machine, as designed by Dr. Ranney, and manufactured by Waite and Bartlett, of New York, is regarded by many persons as that best adapted to meet the chief difficulty involved in the use of all static electricity machines,—that of their being neutralized by the condensation of moisture upon them. This difficulty has never been entirely overcome. In the Waite and Bartlett machine, as in others inclosed in a glass case, chloride of calcium, or some other bibulous chemical substance, is used for absorbing moisture affecting the instrument during the summer months. The introduction of a source of heat for the purpose has been essayed, but no device for the purpose has proved entirely satisfactory; an alcohol-lamp, which has been tried, only increasing the difficulty. If ever a small incandescent burner, in its vacuum, can be introduced into the glass case, the difficulty will receive its solution.

AN ELECTRICAL TONIC BATH.

As a refreshing **tonic bath,** static electricity is often administered by seating the patient for a quarter of an hour upon the insulating platform, and connecting it with one or the other of the two poles of the machine, according to whether it is desired to give a positive or a negative charge. The other pole is, of course, connected with the ground. The poles are also separated as far as possible before the machine is put in action.

THE STATIC BREEZE.

This simple method of administering static electricity can be modified by turning the slow dissipation of the electricity from the body of the patient into a rapid current of considerable volume. This is called producing the static breeze, and can be accomplished either directly or indirectly. The effect being the same in each case, the mode of its execution is only a matter of detail. In the **indirect static breeze** the patient remains as before, insulated on the platform, with one pole of the electrical machine connected with it, and the other connected with the ground, preferably to a wooden floor, to some pipe which runs to the ground. The operator, then, by means of a chain fastened to

some other pipe, and terminating in an electrode of some sort, draws off the electricity in a rapid current from the person of the patient. The electrodes used for this purpose are specially designed for it. They are made of both metal and wood, and have single or multiple points. Dr. Ranney remarks that when the operation is performed near the eyes the electrode used should be of wood.

In the method of producing the **indirect static breeze** it will have been observed that, one pole of the machine being connected with the insulating platform and the other pole with the ground, the electrode which the operator holds in his hand, connected by a chain to a gas-fixture or some such thing, is an intermediary in the affair. It does not represent one of the poles of the machine; it is not associated with them except in the most indirect manner. It represents a conduit through which the electricity in the person of the patient tends to flow off into the earth by means of the electrode, chain, and gas-fixture communication with the soil. In the method of producing the **direct static breeze,** however, the electrode held by the operator is not an intermediary in the production of the phenomenon. It is directly connected with one of the poles of the machine, while the other pole remains connected with the insulating platform. That is to say, that the pole which had at first been the ground connection of the machine is now, in a modified form, in the hand of the operator.

THE DIRECT AND INDIRECT STATIC BREEZE BY MEANS OF THE UMBRELLA ELECTRODE.

An electrode called the **umbrella electrode** is sometimes suspended over the head of the patient as he sits in the chair on the insulated platform. This electrode, being studded with points, draws off the electricity somewhat uniformly through the scalp. The umbrella electrode may be connected by its chain, either directly to one of the poles of the electrical machine, or else indirectly to some pipe having ground connection. In the first case we have the direct static breeze, and in the second the indirect static breeze, where the permanent umbrella electrode takes the place of an electrode waving in the hand of the operator.

WHAT THE DIFFERENT MODES OF ADMINISTERING STATIC ELECTRICITY RESOLVE THEMSELVES INTO.

The several modifications just described of administering static electricity resolve themselves into the ability to draw sparks from the person of the patient, or to dissipate, in the form of a current, the elec-

tricity with which he is charged. Regarding the matter **scientifically,** neither of these actions represents electricity in a static condition. The disruptive discharge of sparks is dynamic, and a current, however feeble, is dynamic, or at least not static.

DETAILS OF MANIPULATION IN TREATMENT BY STATIC ELECTRICITY.

To confine ourselves to the question merely of treatment, we would say that brass balls of various sizes are provided for the purpose of drawing sparks from the body of the patient. Other things being equal, a large ball will produce a spark of greater volume than a small one does, and its action will be the strongest at the distance at which it is capable, through the difference of potential in the machine, of putting stress upon and breaking down the dielectric resistance of the air interposing between the pole and the body. The object sought in the withdrawal of sparks from the body of the patient is stimulation for skin or other affections where healthful action is to be initiated. The brass balls referred to, with insulating handles, are held in the hand of the operator, and readily draw sparks through the clothing of the patient. If, however, any limited spot is to be treated, of course sight should be introduced to determine the spark exactly to that point. The sensations of the operator experimenting on himself, and the sensations of the patient verbally communicated to the operator, will guide the intensity of the administration. The effect of drawing a vehement spark is to make on the skin the appearance of an urticarial wheal, and this may be too often repeated in the same spot.

A **metallic roller** is employed in franklinization. This is used directly on the skin or on the clothing over the person. When used directly on the skin the effect is scarcely perceptible, but if used with the intervention of the clothing there is a prickling discharge of sparks that produce a sensation vividly perceived. The difference observed is strictly in accordance with general principles. With perfect contact conduction takes place without disruptive discharge. With the intervention of the clothing the stress put upon the intervening dielectric (the air permeating the clothes) breaks down with the disruptive discharge of the spark. As, however, the roller pressed against the clothes leaves only a slight film of the dielectric to be pierced, the stress on it is reduced to nearly the minimum for each individual spark, and the intensity of the aggregate of sparks is reduced by the fact of their multiplicity approaching the condition of conduction. This roller process will produce in the cutaneous nerves a **stimulating effect** analogous to that produced by the faradic current, but the effect will not, as with the faradic current, be appreciable, except through reflex action, below that surface.

A MOOTED QUESTION AS TO AN ELECTRICAL APPARATUS.

We now approach a mooted question, which is, whether the static machine can produce a current performing the same functions as the galvanic and faradic currents, and beyond that two other questions, whether, granting for the sake of argument that it is capable of so acting, it so acts equally well in those spheres, or even well, with valuable differential differences. So far as we are able to judge of the matter, the claim to make the static machine perform the functions of the galvanic and faradic apparatus is not admissible on any higher ground than on that of the ingenuity of the invention. But the fairest way will be for us to give, in connection with this matter, the views of those who think differently. Accordingly, we quote, as follows, from Drs. Bartholow and Ranney. Dr. Bartholow says :—

"Owing chiefly to the physicians of Guy's Hospital, London, and Dr. Charcot and his pupils, Dr. Arthius and Dr. Vigouroux, of Paris, the use of static electricity as a therapeutical agent has been revived and rendered entirely practicable. Dr. Morton, of New York, and the author simultaneously arrived at a method of using the Holtz electrical machine as a means of stimulating muscular contractions, and as a substitute for the faradic current in cases requiring such treatment. . . . . The Holtz machine may also be employed to procure the muscular effects hitherto obtained only from faradic appliances. The current passing between the discharging-rods can be tapped by means of a flexible wire attached to the outer coating of one condenser, and another flexible wire connected with the brass knob or bar which is in communication with the interior of the other condenser. The strength of the current and the rapidity of the interruptions are regulated by the distance between the knobs of the discharging-rods. At every passage of a spark a muscular action takes place. If the knobs are placed very near each other, so rapidly do the sparks pass that the effect produced is very like that obtained from a mild faradic current. Thus, by an arrangement of the machine which can be done on the instant, the actions heretofore only obtainable from the faradic machines are readily procured from the statical electrical instrument. Besides the effectiveness of this method, it has the advantage that it is almost painless. In no other way can strong muscular contractions be induced, with so little pain, at least."

Dr. Ranney, speaking to the same intent, says :—

"To convert a static machine into what to all practical purposes may be considered a 'faradic' instrument, some slight modifications only are required.

"The discovery of this method may justly be attributed to the investigations of W. J. Morton, of New York, although Matteucci first

devised an instrument which gave shocks by induction simultaneously with the discharge of a Leyden jar.

"To produce this form of current it is necessary to first hang a pair of Leyden jars upon the arms of the machine. The size of the jars employed modifies the strength of the current. Hence it is necessary to have jars of different sizes as a part of a static outfit. You now attach the chains—or by preference insulated wires which serve to connect the machine with the patient—upon the hooks that rest upon the outer coating of the jars. Finally, you attach to the other end of each rheophore an electrode for use upon the body of the patient. The electrodes may be of metal without any covering, or ordinary sponge-covered electrodes may be employed, care being taken that the insulating handles are somewhat longer than usual.

"Before the machine is set in motion its poles should be approximated closely. This step is important, because the separation of the poles intensifies the current as long as a spark will pass between them. There are **two factors**, therefore, in determining the strength of the static-induced current,—the size of the jars, the extent of separation of the poles."

This claim seems to us well answered in a general way by Drs. Beard and Rockwell, and, with a brief quotation from their work on "Medical and Surgical Electricity," we will close the discussion. It is there said:—

"It is claimed for this current that it produces maximum muscular contractions, with a minimum amount of pain, and that the response is quicker than that from the faradic current. As for the first claim, it is difficult to see how it can be determined, since the ordinary faradic current, from the single coil apparatus especially, need seldom call forth pain in the production of muscular contractions. As to the alleged greater quickness of response, I have not as yet been able to satisfactorily form an opinion. The change in the apparatus for the production of this current is quickly and easily effected, and for the purposes of localized electrization it is useful. For general faradization, however, I can confidently assert that it is far inferior to the current produced by the best faradic apparatus."

THE QUESTION OF THE PROPRIETY OF ELECTRICAL SHOCKS.

By some electro-therapeutists shocks from the **Leyden jar** are given, for what purpose is inconceivable. Shock of all kinds is objectionable. Perhaps such persons imagine (there are such) that because a thing is capable of certain performances, it must be called upon to do everything of which it is capable. But a horse can rear so as to dislodge his rider, or even so as to fall backward on him, and yet no one considers it

advisable to put him through his paces to the extent of incurring that shock. Shocks of any kind are, even when one is well and hearty, objectionable enough, but they are frightful to a sick and nervous man.

AFFECTIONS NOTABLY RELIEVED BY THE ADMINISTRATION OF STATIC ELECTRICITY.

The administration of static electricity is recommended for, as favorably influencing, certain **nervous disorders,** and therefore such affections of the skin as are presumed to be associated with disturbance of the general trophic system are believed to be amenable to it, both directly and indirectly.

Prurigo, as can readily be believed, is modified by the stimulating effects of the **roller** franklinization.

Formication, as the concomitant of **certain nervous lesions,** is sensibly abated by the administration of franklinic baths. The only peculiarity of the electric-bath administration of electricity, as compared with the other, by **insulation,** is that the current is more sensibly felt by the body, and probably more fully taken up by it, on account of the relatively resisting character of the surrounding medium of water.

Just as from the **galvanic** and **faradic** currents we obtain **general** and **local** effects, so, from **static electricity** we obtain similar results, without the passive exercise which is combined with galvanization or faradization. Though exciting to healthy function, **lividity of the skin** is dissipated under the stimulating effect of the multiple spark from the **electric roller. Anæsthesia** and **hyperæsthesia,** different as they are, are ameliorated by the same process.

The pain of **muscular rheumatism** is believed to be better relieved by roller franklinization than by any other means.

Neuralgias of various types are also frequently relieved by this kind of administration of franklinization. Beard and Rockwell, however, declare that, in the various forms of true neuralgia, franklinization does not compare with galvanization. They say that the neuralgias which are most amenable to franklinization are those of a **chronic character,** confined to no special nerve-trunks, with the character of dull aching, and the parts not tender upon pressure.

Hypertrophies of the skin, such as those of **callosities, corns, horns, cicatrices,** and **scales,** are often relieved by the method of **drawing sparks** from the diseased surface.

Treatment for absorption in **chronic synovitis,** by sparks, is recommended by Beard and Rockwell as being frequently better than the treatment by galvanization and faradization.

Blind boils may be aborted by drawing sparks sufficiently strong from the inflamed surface.

In **eczema** and **psoriasis** the same method of treatment is often effective.

Acne marks and **hard papules** are frequently removed by the same process.

Sluggish lymphatic glands may be stimulated to better performance of their function by drawing sparks from them.

Obstructed local circulation, from great infiltration, is relieved by franklinization.

The **roughness** of the skin from **scrofulosis** is much ameliorated by franklinization.

The **eczema of children,** known as "**scald-head,**" is ameliorated by franklinization.

In **hyperidrosis** of the **feet** and **hands** franklinization has proved a valuable remedy, and in **itching** of the feet and hands, often afflicting the very aged, franklinization affords great relief.

Ringworm has been extirpated by franklinization.

The rare and painful lesion of the skin caused by the **presence** of the **guinea-worm** has been cured by destroying the animal by strong and continuous sparks.

Sycosis is sometimes relieved by franklinization.

Spasm of the **eyelids,** or of the **corners** of the **mouth,** in nervous or hysterical patients, frequently yields to franklinization. The **weeping concomitant** of this kind of spasm is in general favorably influenced by the same treatment.

Locomotor ataxia, difficult as it is to deal with, often seems to have better outlook from treatment by franklinization than by galvanization or faradization.

Hæmatocele is treated, depending upon the character of the case, by **faradization, electrolyzation,** or **cauterization.**

Conclusion.—To proceed further in the discussion of static electricity and in the mention of its applications would unduly expand that portion of this treatise which had been allotted to the subject, and would in consequence also render it disproportionate in its importance, as we conceive it, with reference to the subject of electro-therapeutics as a whole.

It was with set purpose that we did not, as many writers on electro-therapeutics do, begin the subject with the discussion of static electricity. This would be the proper method if one intends to write a history of the discovery of electricity, and treat of its physics, and then of its therapeutics. The intention of the preceding pages, however, was not that,

but to place compendiously before the reader an account both of the physics and the therapeutics of electricity, without regard to historical sequence in discovery, because one is best graduated in the science and art concerned by beginning first with the study of the direct current, then passing to that of the induced current, and then concluding with that of static electricity.

Two reasons conspire to make this the best course to pursue. In the first place, the therapeutic value of current electricity is, as well as we can judge, far beyond that of static electricity. In the second place, every one is nowadays more familiar with the action of current electricity than with that of static electricity. Time was, and not very many years ago, when familiarity with the general phenomena of electricity was all in the other direction. The generation of physicians, our predecessors and instructors, which is passing away, was familiar in its youth with the phenomena of static electricity, and with no other, and had little knowledge and correspondingly little faith in its therapeutic value. They had followed a generation which had expected great things of static electricity, only to see it fall, as magnetism did within our own times, into the hands of charlatans; and, proportionally disappointed, that generation had transmitted their loss of faith to their successors. Now a new era has arrived, with a partial revival of faith in the therapeutic value of static electricity, a faith better grounded than that which preceded it, because based on experiment, cautious in development, and therefore one less likely to be, as was the former, suddenly dethroned. At the same time, if we may venture to speak out frankly our own minds as to the therapeutic future of static electricity, we must say that, judging of it from its physics, and in the full light of therapeutic experience with it, it will never conquer a place at all comparable to that already occupied by current electricity in the armory of medicine.

OXYGEN.

GENERAL CONSIDERATIONS.—While it has long been recognized by physicians as well as the laity that the presence of oxygen was necessary to sustain life, it has probably received less attention than some other matters in the way of relieving disease. Food, water, clothing, shelter, all have received the attention of the physician, but from the **hygienic stand-point** very little attention has been given to the necessary measures for purifying the atmosphere, and for the removal of filth, and for supplying a pure air for breathing purposes. With each inspiration a certain amount of atmospheric air is taken into the lungs for distribution

throughout the system, a portion of which is oxygen; and it has been estimated by Liebig, the eminent chemist, that not less than thirty-two and one-half ounces were consumed daily in the way of ordinary breathing. There have been attempts made in the way of medical treatment with a view to **increase** the **oxygen** in the blood by means of the exhibition of certain medicines which were supposed to convey this important element into the system; chlorate of potash, preparations of iron, and other substances have been given with this object in view. When we think of sending our patients away for the benefit of their health, the **atmospheric conditions** likely to be met with at the point of destination are always considered; the question arises as to the humidity and the amount of ozone, for instance, which is contained in the atmosphere. From personal experience and observations we know that during ordinarily cold weather the **heat** of the **body** is maintained through the active agency of oxygen; the appetite improves, digestion is carried along more completely, and, as a rule, we feel much better than during an unusually hot period,—a fact going to show that the oxygen taken into the system plays an important rôle in the matter of health. We know also, from study and experimentation, that **oxygen** which is inspired **reappears** in some other form, but the knowledge is not general that when a superabundance of oxygen is taken into the system and thrown off this oxygen has been deprived of its vitality, and that it will not support animal life. This brings us to remark what has long been recognized, that oxygen is the **vital element,** and if such is the case in many instances its inhalation at sufficiently frequent intervals may be made to answer in the place of a trip to the mountains, a journey abroad, or a visit to the sea-shore, and it will thus be made to serve the physician in enabling his patients to attend to their regular duties, remain at home with their families, and enjoy the satisfaction of being well notwithstanding the undesirable season of the year.

Increase of **weight** is not always accompanied by increase of strength, and this rule may be applied to the body as a whole. Increase in weight often means an accumulation of excrementitious products which should be eliminated, and in the elimination of which oxygen forms an important element. Such a condition is referred to as that of **suboxidation,** the function of oxygen being to consume these excrementitious products, prepare them for elimination, and if that duty is not properly attended to the health becomes impaired; there follows loss of strength, and possibly it is at those periods that **ptomaines** are so **freely developed** that poison overcomes the influence of phagocytes and undermines the health, destroys the constitution, and makes the subject more susceptible to deleterious influences.

Notwithstanding these observations, the truth of which cannot be denied, objections have been urged against the practice of the inhalation of oxygen. It is said by some that oxygen is harmless in country regions, in normal condition, in combination with other ingredients of atmospheric air, and that if we wish our patients to get the full benefit of nature's most efficient restorer, there would be the place to send the patients; but this is not a practical view to take of the matter because it is very often impossible to comply with measures of this character, and even could we distribute our patients in this manner it is doubtful if much good would be accomplished from the fact that so many are unwilling to practice the necessary methods. They will not breathe systematically and regularly, and are unwilling or often fail to take the necessary amount of exercise for the purpose of assisting nature to throw off the objectionable accumulations in the system. Another objection is, that by this method a condition called hyperoxygenation may be produced, which will be dangerous to the life of the patient, as in the use of cabinets for the purpose of making experimental demonstrations to determine the effect of oxygen when given to excess. This objection might stand, but ordinarily as practiced it has but little force from the fact that the tissues will only take up what is needed. If this latter objection is not sufficient we are met on the other hand by one from the other side, to the effect that the limited amount of oxygen taken during a single sitting or at several sittings is so small that but little benefit can be gained from the method requiring such a short time for its performance; but if this objection were well founded the same would be offered against medicinal treatment because of the limited amount which is required to produce an effect, and especially would this be applicable to the use of antiseptic measures in surgical practice. But those who have witnessed the marvellous effects following the introduction of a small quantity of medicinal substance into the system, and the wonderful improvement attending upon the antiseptic treatment of surgical cases, as well as the truly remarkable effects which follow upon the exhibition of oxygen gas, will not be dismayed by such flimsy excuses.

A further confirmation of the value of the method. if one were needed, may be found in the rapidity with which sulphuretted hydrogen gas, given according to Bergeon's method, is distributed throughout the circulation, only a few moments being required until the whole system is charged and its presence can be detected in the air exhaled from the lungs. Ordinarily in the use of drugs, except by intravenous injection, we do not expect immediate results, but those who look with disfavor on the use of oxygen assure us that the action is not prompt, and insist that even if benefits are immediate they must of necessity be rather

evanescent in character; but these **objections** are fully **answered** by the prompt control of the seizures connected with the attacks of spasmodic asthma. A patient so exhausted that he is scarcely able to walk, and unable to speak above a whisper that is barely audible, will be able to speak aloud after a few inhalations of pure oxygen gas, and will exhibit a marked change for the better, although inspiration is so shallow that but an infinitesimal portion of the gas reaches the pulmonary tissues. An **example** of this kind amounts to a demonstration concerning the influence of oxygen upon the blood and upon tissue-change. A change has been effected which cannot be produced by medicine, by exercise, nor so promptly by change of climate, and when attacks of this character are not complicated by a diseased condition of the upper air-passages the judicious use of oxygen will prove quite sufficient to carry the patient over that period or season which may be regarded as the exciting cause.

As an **adjuvant** to the treatment of **diabetes,** Bouchardat has shown that gymnastic exercises are superior, and cases have been recorded in which the patients became aware of this peculiarity and acted accordingly, taking more than the usual amount of exercise after indulging in the pleasures of the table; but now comes the announcement from Demarquay that diabetic patients not only improve under the inhalations of oxygen, but also that favorable changes are effected in the composition of the urine without any change in the diet whatever. The statement is also made that in a number of cases the actual amount of **sugar** was **decreased,** in some cases as much as **one-half** that which had been present previous to the exhibition of the gas. Beddoes and Demarquay have taken special care to note from time to time in their writings that none of their patients had suffered any inconvenience from oxygen inhalations, and, lest any apprehensions should be felt by those who may wish to adopt this method of treatment in their practice, the statement is made here that unless the patient is confined in a closed cabinet, by which oxygen alone is supplied to him, **no danger** need be feared from its administration by ordinary methods of inhalation, and the notion of **superoxygenation** taking place and damaging the patient's health is only a man of straw, as no more will be absorbed than is required by the condition of the system. **Exceptions** should be made to the administration of the gas by rectal insufflation, its injection into the peritoneal or the pleural cavities, and, as has already been noted, its administration by the use of closed cabinets. This question, however, finds an apt solution by presenting a factor of great practical utility in reference to its use in the treatment of **diseased tissues,** as noted elsewhere in this article. The healthy tissues are unaffected by its application, while the diseased tissues

are destroyed and the part rendered healthy. A table based upon the work of Beddoes shows that he used oxygen in a great variety of cases, nearly one hundred in all, and that more than one-half of them were cured; about one-third were relieved, and in the remaining number it failed altogether. But that is not an argument against the use of the remedy, because there are many cases which have progressed to such an extent that no known method of treatment will be successful, and is but a proof that **oxygen inhalation,** like all other remedies, has its **limitations,** —a subject that will be further discussed under the head of Therapeutics.

The investigations of Ehrlich, as noted in Brunton's "Croonian Lectures,"* are thus summed up, and very fully cover this question of hyperoxygenation:—

"The production of acidity, or rather, in most cases, the diminution of alkalinity in the protoplasm, lessens its **affinity for oxygen,** and thus the process of combustion in the cell is diminished or **arrested** by the formation of **acid,** though oxidation again begins as soon as the circulating blood or lymph has restored its alkaline reaction. The activity of the cell tends to generate acid products of tissue waste, and these will be formed all the more quickly the more actively the functions of the cell are going on. But their accumulation will tend to lessen the alkalinity of the cell, and consequently its affinity for oxygen. The processes of **combustion** will then diminish or **stop** entirely until the waste products have been removed. There is thus a sort of self-acting mechanism in the cell, which, to a certain extent, regulates oxidation within it. Yet this regulating arrangement, which might be likened to the appetite, which prevents reasonable people from eating too much, does not seem to be enough, for we find a further one, which actually prevents the oxygen from getting to the protoplasm, and with the few exceptions of the brain, heart, and some of the muscles, the tissues of the body are shown by their reducing power to have only a restricted supply of oxygen, or, in other words, are burning like a furnace-fire with partially closed dampers Now the question arises, how is the **supply** of **oxygen** to the protoplasm **restricted,** and how is it that the supply may be, if necessary, increased? The damper which restrains combustion in the cell is, according to Ehrlich, the **paraplasm,** or cell-juice which surrounds the protoplasm. This paraplasm presents considerable **resistance** to the diffusion of oxygen through it, and thus restricts the quantity which reaches the protoplasm.

"The amount of oxygen which will pass through the paraplasm and combine with the protoplasm will vary according to the thickness of the paraplasm and to the area of surface of the protoplasm. When the protoplasm is contracted to its utmost extent, it will form a globe presenting

* British Medical Journal, 1889.

a minimum surface to attract oxygen, and with a maximum thickness of paraplasm around it. When the protoplasm is extended it will present a maximum surface with a diminished thickness of paraplasm. It will, therefore, attract oxygen more readily, and combustion will go on more quickly within it."

These preliminary remarks seemed to be demanded on account of the **meagre references** to the subject found in the text-books of the present day, many of them ignoring the subject entirely, while a few treat of the matter but in the most superficial manner.

The **attention** which the oxygen treatment has received in this country and abroad during the past ten years is sufficient to warrant a consideration of the matter, and the success claimed for it by irregular practitioners is such that the regular physician cannot afford to be without some general knowledge of its utilities, and it is of such a nature that a careful investigation is warranted. The **object** of the **present article** is therefore to present the matter from the stand-point of practical utility, in the hope of enabling those who wish to adopt the method in their practice to determine the cases in which it will be beneficial, and the cases in which it will not be of value. An article somewhat elaborate has therefore been prepared, but it is none too exhaustive for a work of this character. It will be found to contain a brief reference to the **early history** of the subject, and not only the **methods** of **preparation** and **exhibition** of oxygen gas, but the uses and methods of administering the **peroxide of hydrogen** and **nitrogen monoxide**, commonly known as nitrous oxide, together with brief reference to **ozone**, its action, and to **glycozone**.

In this connection the authors desire to express their thanks and appreciation of the courtesies extended by Dr. S. S. Wallian, of New York, who has completed a translation of the excellent work of Demarquay, which will soon be within the reach of physicians of this country. The active exertions of Dr. Wallian in bringing this method of treatment to the notice of the profession in America should be appreciated by all who are interested in the progressive spirit of the age.

HISTORY.—Oxygen was first isolated in 1774 by Priestley, and its name is derived from two Greek words,—*ὀξύς*, sour, and *γεννάω*, to generate,—which were intended to convey some notion as to its character, from the fact that other elements combined with it and dissolved in water produced acid solutions. The discoverer anticipated an unusually promising field for it from a therapeutic stand-point, but we are forced to the confession that only within late years has much been accomplished in this direction. The indorsement of Lavoisier was equally complimentary, but he, like many others who have followed him, entertained an idea that

its application in disease might result disastrously to the patient by reason of the property it possesses of rapidly breaking down the tissues. The theories of Fourcroy were chimerical in the extreme, and calculated to arouse suspicion from the exaggerated claims put forward. In his opinion it became at once a remedy of universal potency, and the value of all drugs was estimated in proportion to the amount of oxygen entering into their composition, and the remedies then in use were even classed in two divisions and referred to as oxygenators and deoxygenators. Beddoes, already referred to, the gifted professor of chemistry at Oxford, was more judicial, although he advanced his opinion concerning its use with that conservative modesty which failed to inspire his readers with great confidence in this new and untried therapeutic agent. But other scientists took up the subject and studied it with great interest, Sir Humphry Davy and Liebig among the number. Birch, of the Manchester Medical School was an enthusiastic advocate of its introduction into medical practice, and within late years numerous investigators have given the subject more or less attention, some of whom have claimed that the blood cannot absorb more oxygen than is contained in atmospheric air, and that all attempts to increase the quantity by the usual methods must prove futile. This matter we have already considered, and the large number of competent observers who have demonstrated the utility as well as the harmlessness of the agent renders any further attempt in its defense unnecessary, although the careful physiological experiments of Claude Bernard, Paul Bert, and Burdon-Sanderson effectually settle the question. The physiological and clinical **tests** made by Demarquay and others in France, Germany, and England, and those of Dalton, Kellogg, Thompson, Humphrey, Love, and others in America, fully corroborate the views here advanced.

PREPARATION.—Oxygen is a tasteless **gas** without color or odor, and slightly soluble in water, one hundred volumes at the ordinary temperature taking up but three volumes, but all attempts to liquefy it have proved fruitless. Substances which burn in the air are consumed with much greater rapidity when exposed to this gas, but, while it unites with other bodies in a state of combustion to form new substances, the gas itself is **incombustible.** The term incombustible, however, is rather a relative expression, because, while in some instances it may be a supporter of combustion, under other conditions the gas is burnt, and the weight of the product in all cases will be the weight of the body burned plus the weight of the oxygen consumed. Heat and light attend upon the combination which is called **combustion**, the body consumed being called the combustible, and that in which the operation takes place the supporter of combustion. **Oxidation** is the term given to the combination of oxygen

with other elements, and in every instance heat is produced, although the rapidity of the action may be insufficient to produce light, this being the principal **difference** between oxidation and combustion. Although oxygen is the most abundant and likewise the most important of all the elements, forming one-fifth of the atmosphere, and the largest portion by weight of water, and, in addition, being found in considerable proportion in all animal and vegetable substances, its preparation in the form of free gas is not always accomplished without difficulty.

First obtained by Priestley by **heating mercury** with common air, Chaptal found, in using this gas for medicinal purposes, that salivation followed, and experiments instituted to discover if mercury were present showed that prepared in this way at least one-third of a grain to the pint was carried by the gas, and of course that process was immediately abandoned. **Other metals**, like gold and platinum, whose oxides have but little affinity for oxygen, have also been used for obtaining the gas, but it remained for Graham to discover a method of **dialysis** by which superoxygenated air could be made from ordinary air. For this purpose very thin India rubber is used as the membrane, and is supported on cloth, the apparatus being in the form of a bag to which an air-pump is attached. The contents of the bag having been exhausted, the pump will continue to deliver air more highly charged with oxygen, or containing about twice the quantity of ordinary air (41.60 per cent.).

Other methods of obtaining oxygen may be mentioned as follows: From the decomposition of peroxide of manganese or by its combination with sulphuric acid, but both methods are open to objections owing to the great amount of heat required by the first process, and the dangers attending the use of sulphuric acid by the second, and the fact that impurities in the gas thus prepared are removed with difficulty, while the yield is uncertain, and, besides, gas made in this manner may be dangerous. The gas obtained from decomposition of chloride of lime is not great in amount, and has to be subjected to frequent washings to free it from chlorine. Oxygen in large quantities can be obtained from barium dioxide by a series of complicated operations, but attempts to use this method except for its preparation on a large scale have been found impractical. Efforts to procure oxygen from the decomposition of sulphuric acid or zinc sulphate by heat have not been successful owing to various causes, although Richardson claims that it can be made in abundance from the use of sulphuric acid acting upon potassium bichromate. This latter method has the disadvantage of requiring that sulphuric acid, always dangerous, shall be handled in considerable quantities, while the yield must be comparatively limited, and it has also the disadvantage that it must be used as fast as prepared. When the potassium bichro-

mate is heated with sulphuric acid, oxygen is evolved, and the solution promptly changes to yellow. Bouchardat's method consists in the use of equal parts of peroxide of manganese and peroxide of barium upon which rectified pyroligneous acid is gradually formed, but this is also open to the same objection as that of Richardson, since there is no arrangement for determining dosage.

Potassium chlorate, however, furnishes the best means of obtaining oxygen, and the gas obtained from it has the advantage of being almost pure. The decomposition of this substance by heat results in the production of potassium chloride and oxygen, but for this purpose an unusually high temperature is required. To obviate the difficulty it is only necessary to add to the chlorate one-eighth of its weight of some metallic oxide; copper oxide, ferric oxide, or the binoxide of manganese may be used, when the gas will be given off with great rapidity at a much lower temperature, while the metallic oxide remains unchanged at the close of the operation. About the **only objection** to this plan is owing to the contamination of the gas from the presence of chlorine, but this can be obviated by passing it through a solution of caustic soda, and this is substantially the method we have adopted for the preparation of the gas for use at the homes of patients, and for office treatment. But little **inconvenience** attends its preparation, as twenty-five gallons can be made in fifteen or twenty minutes, and by means of India-rubber bags this can be kept on hand for a period of twenty-four hours without injury. Prepared in this manner the **amount** taken by each patient can be estimated, if not **actually measured,** while the **expense,** aside from the first cost of the plant, will be comparatively trifling, certainly not more than two cents per gallon.

ADMINISTRATION.—The dosage is by no means arbitrary, but must be regulated according to the condition of the patient. When given by inhalation in **ordinary cases** the amount will range from one to ten gallons, and this may be taken daily. When the patient suffers from excessive pulmonary secretion, as in **bronchorrhœa,** the gas should be passed through calcium chloride to remove from it any moisture, although at other times it may appear advisable to pass the gas through moderately warm water in order to warm it, and to have it moist at the same time. As a precaution for the purpose of **avoiding impurities**, it is recommended that at some period of its preparation this gas should be passed through absorbent cotton in addition to the washing process already described. **Urgent cases,** such as hæmorrhage, shock, opium narcosis, asphyxia from any cause, will require the administration of gas in its undiluted state, without its admixture with atmospheric air, but generally this is not demanded, as the method is attended with loss of gas unless the

patient can be made to understand the advantages to be gained from forcible inspiration. When it is necessary to bring **children** under its influence who are too young to be guided by instruction, and when the plan of rectal insufflation cannot be adopted, a mouth-piece similar to that used by dentists for the administration of nitrous oxide will be found to answer the purpose admirably. In the exhibition of the gas, either by inhalation or by rectal insufflation, the **addition** of a small proportion of **nitrous oxide** will often be found a valuable adjuvant, owing to its anæsthetic properties; but as this action is supposed to be due largely to its influence in depriving the nerve-centres of oxygen, its continued effect is not desirable.

PHARMACOLOGY.—The question arises at the beginning of this investigation as to the manner in which oxygen gas acts when taken into the system. We know from observation that often the effects are immediate; but there are other instances in which the effects apparently are delayed, and we conclude very naturally that the first effect—that is, the **primary effect**—is upon the blood; and we are, therefore, warranted in assuming that the **secondary effect** is upon the nutrition; that the oxygen is carried by the blood-corpuscles and deposited within the tissues; and that the active changes that normally take place and favor the elimination of excrementitious products are carried on more promptly. It thus **favors absorption**; at the same time it increases the **elimination** of excrementitious materials. The effect upon the blood is very prompt, as shown by the investigations of those who have given the matter attention. By introducing a small quantity into the lower bowel by means of rectal insufflation, and exposing during the *séance* the omental tissues in which the blood presents the venous hue, the addition of a small quantity of oxygen in a few moments will cause this venous blood to change its appearance and become distinctly arterial, or red. Of course, the inhaled oxygen reappears probably in the form of carbonic acid and water if the combustion of hydrocarbons brings about their elimination by the lungs, while the fatty and nitrogenous products are converted into uric acid, hippuric acid, and urea, the sulphur of the latter being converted, and the products eliminated, by the kidneys.

From these observations we are prepared, in a measure, to estimate the **value of oxygen** and what is meant by the expression **suboxidation**; and we are also in a position to understand the advantages which are claimed for quite a number of remedies, including chlorate of potash, iron, and other preparations, by reason of the supposed value they possess in depressed conditions of the system characterized by suboxidation. As a rule, no unfavorable constitutional **symptoms** follow its administration by **inhalation**; but, on the contrary, a general feeling of

well-being is experienced; there is cerebral stimulation and an unusual buoyancy characterizes the movements, all sense of weariness disappears promptly, conversation is more active and direct, the ideas concentrated and forcibly expressed, while the step is firm and elastic. Hayem's observations show that when given in combination with a proportion of atmospheric air there is decided improvement in the functions of nutrition.

The **general action** is that of a stimulant, by which the whole nervous system is affected, the activity of the circulation is increased, and the functions of respiration are more perfectly performed; the temperature at first is slightly elevated, as well as the pulse; digestion is carried on more promptly; and the function of the red **blood-corpuscles** is greatly augmented and often their form remarkably changed by oxygen inhalations. Instead of being depressed in the centre and presenting a shriveled appearance, they are full, rounded, and have every appearance of robust health, a change which is effected generally throughout the entire system, although, of course, this is not long continued from a single exhibition of the remedy; but by repeated inhalations decidedly beneficial results may be witnessed.

Of the various **theories** relative to **respiration** that of von Marrow is of most recent origin, and is probably more tenable than any other. According to this observer oxygen is not merely an oxidizer of carbonaceous and excrementitious products, but is extensively absorbed, both as a tissue builder and as a prime instigator and chief promoter of general metabolism and tissue metamorphosis; and, viewed from this standpoint, the claim is not unwarranted that this element is destined to occupy an important position in therapeutics.

Difficulties present themselves in the course of the preparation of an article of this character, and it seems advisable to remark here that in order to understand fully the benefits to be derived from this method of treatment the physician should have the advantages of personal observation and experience. So many cases are daily presenting themselves which would receive great benefit from the treatment, and yet it is impossible almost to point out the special cases which are likely to be affected favorably from oxygen inhalations or its use in some other form.

THERAPEUTICS.—At the beginning of the present paper we took occasion to speak of the hygienic relations connected with the uses of oxygen, and we desire again to emphasize the needs for taking that matter into consideration. **Respirable air,** such as we find in large cities, and even in some of the smaller where much manufacturing is going on or where the location is unfavorable, will often be found **contaminated** with gases which are extremely obnoxious when taken into the lungs in concentrated form. These gases and odors permeating the

atmosphere constantly are calculated to have a depressing effect upon the system, although the plan of taking **summer vacations,** which now prevails, will have a tendency to modify this feature of modern civilization, for those who can afford it, provided proper **sanitary precautions** are adopted at the various summer resorts.

The application of oxygen as at present conducted covers a wide range of diseases, and, although not always curative, its use certainly has a **favorable influence** upon the progress of quite a number of maladies,—a result which probably follows because of the power which is thereby added to the organism to resist disease. The natural **supposition** is that it modifies the nutritive character of the red blood-corpuscles and affords increased vitality to phagocytes, which, as we have pointed out, are the enemies of disease. This, however, does not take into account its general **revitalizing** action upon diseased tissues, which will be noted farther on under the head of Hydrogen Dioxide. A familiar example of this action may be seen in the **decay** which attends upon the exposure of organic matter to atmospheric air for any considerable length of time, although a **mistaken notion** exists regarding the rôle played by the oxygen contained therein. The process of decay is not wholly that of oxidation, as animal and vegetable substances undergoing a slow process of decay are modified to a great extent by the presence of **micro-organisms,** as pointed out by Pasteur years ago, who showed that when these micro-organisms are excluded decay takes place at an extremely slow and almost imperceptible rate,—a fact which but emphasizes the observations already made concerning the **normal antagonisms** existing in the economy.

The use of oxygen in **anæmia** and other blood **dyscrasiæ** would seem to furnish a crucial test of its practicability, but without the addition of certain **adjuvants,** as nutritious diet and a healthy condition of the primary assimilation, together with medicinal treatment to correct any morbid condition of the system, and such preparations as iron and manganese to improve the condition of the blood, the benefits from its administration will be far from satisfactory. And this leads us to remark again that oxygen is far from being an universal panacea, but in cases that we have mentioned it forms one of the most important adjuvants within our reach at the present day. The investigations of Beddoes and others, while of immense service to us, were made without the knowledge we now possess concerning **hæmatology** and **bacteriology,** and, in the light of more complete information on these subjects, our observations will have a correspondingly increased value from a therapeutical stand-point. **Synergists,** in addition to the above, will also include alkalies, as will be pointed out later, and the use of such alteratives as may be indicated in the particular case. Humphrey, of Whitewater,

Wisconsin, has used successfully cod-liver oil by enema in connection with the rectal administration of oxygen, and claims excellent success from the method. The class of remedies referred to as nervine tonics would also be indicated.

Included in this class of diseases which have been mentioned should also be noted quite a large number of affections which appear to be influenced primarily by the condition of the blood, as in the case of **chlorosis,** or an entirely different class, of which **erysipelas** is the representative. Chlorosis is practically represented in the treatment of anæmia, from the fact that the latter is generally the concomitant of the former; and if to the treatment for anæmia we add the use of emmenagogues, we shall have a pretty good idea of the plan to be pursued in that disease. **Leucocythæmia** would properly come in for a share of our attention in this connection, and it is a satisfaction to know that this malady will show a favorable change under the use of the gas; but its use must be followed up, and, as adjuvants, the benefits of outdoor exercise should be impressed upon the minds of the patients. Erysipelas is one of the diseases which will be modified by the inhalations, but the local use of the dioxide will be more productive of benefit if used in the early stage of the affection before the micro-organisms have had an opportunity of multiplying. The same method will be found available in the treatment of **septicæmia,**—a plan which will be better understood as we come to the consideration of diseases of the alimentary tract on the following pages.

Lithæmia, and its congener, **neurasthenia,** is just such an affection as we should expect would receive benefit from the use of oxygen, and in this disease the appropriateness of the suggestion that alkalies would be suitable as adjuvants will thus become apparent. These cases, as a rule, are met with in which there is a condition of suboxidation; there is cough, showing that excretion by the pulmonary tissues is embarrassed; and there is a highly acid condition of the urine,—a fact which proves beyond question that the combustion is incomplete; and an examination of the urine discloses the presence of large quantities of uric acid,—an insoluble substance which should have been converted into the soluble urea. In addition to the foregoing complications, as if they were insufficient, we have to deal with an unhealthy condition of the alimentary tract, a torpid state of the liver, and a sluggish condition of the entire cutaneous system. With such an array of disorders and complications, is it any wonder that the population of our mad-houses is rapidly increasing? While urging the benefits to be derived in cases of this character, we do not assume that oxygen alone will rehabilitate and rejuvenate a debilitated system, but we cannot too strongly insist that an

investigation of its claims will be well calculated to start the physician in the direct line of investigation, and he will thereby form some idea of the results which follow a more perfect oxygenation of the blood.

At the close of a long list of diseases which manifest themselves through the medium of the blood, **rheumatism** may be mentioned. Both subacute and chronic will promptly respond to the judicious use of oxygen; but when a diathesis has been acquired, and a habit is formed on the part of the system, the use of the remedy for only a short time cannot be expected to accomplish more than palliative results. Other treatment must be instituted with a view to secure a healthy condition of the hepatic function, and everything must be done that can be done for the purpose of purifying the condition of the blood and keeping it in a condition unfavorable to the development of microbes, by which we avoid the presence of the poisons that they form; but this subject has been so fully canvassed that its repetition would be a waste of space.

Whether **diabetes** is a disease which may be properly considered in connection with other affections which apparently have their seat in the alimentary canal, we shall not attempt to say, although its origin is shrouded in obscurity; but there are some points which can be conveniently considered here in connection with its treatment by inhalations of oxygen. Chevereul, we believe, was the first to suggest that much might be accomplished in this disease by the use of alkaline mineral waters, owing to their power to aid the blood in carrying oxygen in increased quantity; and he insisted that under these conditions it would have a curative action,—a point which has been taken up by Mialhe, who claimed to have established upon this basis what he was pleased to term a rational treatment for the disease. By the use of alkaline mineral waters and inhalations of oxygen, saccharine matters in the blood are burnt up, as it is observed that many organic compounds do not combine with oxygen until brought into contact with a free alkali. We know the value of alkalies in the treatment of **uric acid diathesis,** and from what has just been remarked the advantages to be gained from the addition of oxygen will be more fully appreciated.

Possibly Sternberg had this in mind when he adopted the alkaline plan for the treatment of **yellow fever**; but whether he did or not, the fact remains that thus far it has proved more generally successful than any other. True, this plan also includes the use of considerable doses of corrosive sublimate, but, given in the presence of an alkali, we cannot entertain the idea that its value is felt beyond the contents of the stomach; and this, we believe, is all that is claimed for this part of the treatment by the discoverer. The hypodermatic use of pilocarpine accords with the views here expressed in so far as the secretions

are affected, and good results have followed its use in the hands of Hebersmith, who was the first to recommend it to the notice of the profession. If now, to both of these methods of treatment, we are permitted to add the use of inhalations of oxygen gas, and either the rectal insufflation of the same or the exhibition of the hydrogen dioxide, there is reason to believe that better results will follow than by any other method which has yet been suggested.

A similar plan can be adopted for the treatment of **cholera**; and if we may be permitted to anticipate the possibilities of the case, judging from the good effects which attended its use in the epidemics in which it has been used. and which include those of India in 1819 and 1821, and in France in 1832 and 1848, we have great hopes that much may be accomplished in attempting to control the disease, at least in the earlier stages. In both yellow fever and in cholera the poison is to be found in the intestine, and not until the disease has invaded the system do the powers of the organism show a disposition to succumb,—at a time, probably, when the poisons generated from micro-organisms are beginning to overpower and destroy the phagocytes. The **suggestions** here advanced appear to be **confirmed** by the remarkably satisfactory results which have been noted from the use of the gas in that nondescript affection called **dyspepsia**, and in **chronic gastritis.**

The use of **oxygen internally** has not yet received the attention which its value warrants, although it has been practiced to a limited extent in this country. The method was first introduced by Odier, a physician of Geneva, and was advocated as a desirable plan for restoring the energies and increasing the appetite, especially amongst those of a nervous disposition. Wallian has sometimes seen remarkable results follow its use in this manner, the only valid objection which can be offered being that the taste of water impregnated with oxygen is flat and rather disagreeable. This difficulty, however, may be overcome by combining the oxygen with nitrogen monoxide, and it is said the two together not only are taken with a relish, but also that they produce results far superior to that of oxygen alone.

Water holds, under pressure of from fifteen to eighteen atmospheres, three or four times its own volume of gas, and very convenient appliances are at hand for administering it in this manner. **Thus used**, it has been found to possess **great excellence** in all cases of so-called dyspepsia, in cases of convalescence from illness, and in general debility. Along with the foregoing may also be mentioned such affections as asthma and catarrhal fever, as well as tertian. Its value has also been demonstrated in the treatment of all spasmodic affections and as a diuretic in anasarca. In the latter cases it is believed to act strictly as a diuretic, as the uri-

nary flow is greatly increased and *pari passu* the anasarca disappears. In estimating the value of oxygen, therefore, its internal administration should not be overlooked.

Some of the diseases of the **cutaneous system** are especially amenable to treatment of this character, amongst which may be mentioned eczema and urticaria; and it should be noted here that this observation is in direct relation with the views advanced concerning suboxidation. These affections are but indications that the ordinary channels for excrementition have been temporarily closed, when the skin takes upon itself a vicarious function,—that of eliminating products which have been allowed to accumulate in the tissues. Whatever aids combustion of these obnoxious products will favor a return to the health standard, and first on the list of remedies aside from appropriate medical treatment and nutritious diet we should be disposed to esteem oxygen gas.

Pulmonary affections, however, appear to furnish the most promising field for its use, partly because there are a greater number of persons who suffer from various forms of lung and bronchial troubles than any other single disease, and partly for the reason that there is a belief that more good can be accomplished if the remedy goes direct to the affected area than if the diseased part be located at a distance from the point of medication; and doubtless this opinion is shared to some extent by physicians. The **immediate value** of the action of the gas is perceptible when given for the relief of **asphyxia** from whatever cause, and it will be convenient to have access to a preparation of the kind in the case of **emergency.** Not infrequently there will occur cases in which the patient has been exposed to the fumes of coal-gas in a sleeping apartment, when in addition to the usual cardiac and vascular stimulants the administration of oxygen should not be omitted, as it materially hastens recovery and also otherwise acts as a potent agent in re-establishing the equilibrium of the circulating fluid and increasing the nutrition of the nerve-centres. Certain drugs, like **antifebrin,** may cause such depression of the system that collapse may be threatened, but the timely administration of oxygen will often tide over the difficulty. This comes about from the action of the drug upon the red corpuscles which are deprived of hæmoglobin, this substance being converted into methæmoglobin, by which the appearance of the blood is changed from the arterial hue to that of a chocolate color.

Asthma comes in here for a share of attention, and it may be remarked that amongst the cases recorded by Beddoes, by far the largest number of any one class were of this affection, although the matter has already been so fully considered in preceding pages that further discussion would be unprofitable. It is sufficient to say that uncomplicated cases of asthma will be promptly and permanently benefited, but

attention must be given to those conditions which are so well calculated to perpetuate the existence of the disease. Along with asthma comes **bronchitis, dyspnœa,** and **emphysema,** all of them being promised improvement under the use of the gas, together with other measures intended to improve the general nutrition.

Phthisis has undoubtedly furnished the oxygen treatment the largest number of followers ever since its introduction, and for many years there was a general impression that its use was confined to the relief of this scourge to the human race. As a result of this mistaken notion, many who would have given the matter serious consideration have listened to the claims of oxygen enthusiasts with no little incredulity, and unfortunately physicians as well as the laity naturally looked upon it with disfavor, because no one believed that it could cure consumption, and that was what many of its projectors in different sections of the country proposed actually to accomplish. The subject is therefore deserving attention in this connection. In the **early stages** of phthisis, when digestion is impaired, when the function of the liver is not properly performed, and before serious changes have taken place in the lung-tissue, no doubt exists but that much can be accomplished in the matter of stopping its progress, but the use of the gas alone will not do it, and we must call to our aid all those remedies which are known as adjuvants, the object of which is to increase the resistance of the organism. In the **later stages** it is but palliative, but may be used with no little benefit to the patient during the intervals between the exacerbations of fever. And just here it may be remarked that there will be found a considerable number of cases in which the progress of the disease will be but slow, and the benefits to be derived from pulmonary gymnastics would prove advantageous; but with the use of the gas as an incentive, respiration is practiced in a more thorough manner than without it, and there is a corresponding gain in strength, the appetite and digestion improve for a time, and the patient is buoyed up with the hope that a cure has been found and that ultimate recovery is among the probabilities. But when hectic again appears, which it will sooner or later, the sufferer experiences a shock both mental and physical and the resistance of the organism is diminished. Under such circumstances as these we may assume many of the glowing testimonials concerning oxygen inhalations have been written.

Both **croup** and **diphtheria** are diseases in which oxygen may be expected to produce a favorable action by reason of the improved quality of the blood which follows its introduction into the system. It frequently occurs that the virulence of the disease and the strength of the patient are exhausted about the same time; but if we can introduce this plan, in

many cases the vitality of the patient will be prolonged, and he will have strength to recuperate after the activity of the disease has subsided. Upon the same principles it will be found efficient in the earlier stages of **albuminuria,** in which the rôle it plays in eliminating morbid products will be manifested, and temporarily, at least, the progress of the disease arrested. **Neuralgias** of various forms will be often found quite amenable to this method of treatment, many of them being due to an impoverished condition of the blood. The same rule aptly applies to the treatment of that condition known as **general debility,** in which there is a marked depression of all the vital functions, and where the physician is at a loss to determine in which direction his treatment should be aimed.

As an **adjuvant to other treatment,** the use of oxygen will prove of signal service in the relief of **malarial toxæmia,** and very flattering reports have been made regarding its virtues in this direction. From all that has been said of the general action of this remedy in favoring the elimination of waste products which have accumulated in the system, in the treatment of **corpulence** we should very naturally expect to obtain good results from its use, and this is true; a number of observers have already indicated that beneficial results follow its employment.

In **conclusion,** it may be noted that, while a large number of diseased conditions have been mentioned as being more or less favorably influenced by the use of oxygen, scarcely a week passes that some new use for it is not found. **Medical uses** will include its exhibition in the form of inhalations, by rectal insufflation, and lately it has been suggested that oxygen baths be used with a view to obtain cutaneous absorption; its use in connection with beverages is a favorite plan with some. In **surgical practice,** in addition to the methods already outlined, it may be used locally, a more detailed description of which will be found on the following pages under the head of Hydrogen Dioxide, and we bespeak for that section a favorable consideration.

HYDROGEN DIOXIDE (PEROXIDE OF HYDROGEN).

Hydrogen dioxide (H_2O_2) is produced in many cases by slow oxidation in the presence of water; also in small quantity by electrolysis, in which case it is regarded as an oxidation of water. Usually, however, it is **prepared** by double decomposition from barium dioxide and hydrochloric or carbonic acid. Thénard discovered this product by evaporation *in vacuo* over sulphuric acid. It is a colorless, transparent liquid of syrupy consistence, and is probably never quite free from water. In its **pure state** hydrogen dioxide is an unstable product, and in aqueous solution decomposition rapidly takes place when heat is applied, but, to overcome this objection, in medical practice the solution

may be slightly acidulated. The taste is usually slightly acid, otherwise almost tasteless; but it does not redden litmus; when applied to the skin in concentrated form the tissues are turned white, but when used in dilute solution its action is bland and unirritating, and this forms one of its most desirable qualities, as it can be freely used for its **antiseptic properties** in this manner when the use of other remedies would be contra-indicated. Its resemblance to **ozone** is very marked, and, like the latter, it is also a reducing agent of great activity.

The use of hydrogen dioxide is merely another source by which we are enabled to obtain oxygen in different form than in the gaseous if wanted, and is of special value in the treatment of various diseased conditions, amongst which may be mentioned those of **septic, zymotic,** and **parasitic** origin.

The **preparation** of peroxide of hydrogen, as it is commonly called, is somewhat difficult, and, as purity is the most essential feature, there are doubtless many instances in which such a preparation has been used which was either **sophisticated** or contained impurities which seriously interfered with the therapeutic advantages that might have been expected under ordinary conditions. The so-called "**oxygenated water**" is actually a definite compound of oxygen and hydrogen, and yields under favorable conditions four hundred and seventy-five times its own volume of oxygen, but, as already stated, it is somewhat unstable at ordinary temperatures. At times it will decompose other bodies by abstracting their oxygen, and again, coming into contact with those of greater affinity, its own oxygen is yielded to them.

For **medicinal use** a solution sufficiently stable is prepared containing twelve to fifteen volumes ($2\frac{1}{2}$ to 3 per cent.), and a product of this character is to be found upon the market which, with the exception of a slightly acidulous taste, from a trace of acid added as a preservative, cannot be detected from pure distilled water.

The preparation referred to has been called **ozone water,** and it has even been claimed that ozone and H_2O_2 are identical, and that the former represents an **allotropic form of oxygen,** and is a compound body. Submitted to various laboratory tests, Richardson has shown that hydrogen dioxide readily imparts free oxygen; and in accordance with facts pointed out by these investigations certain therapeutic indications have been formulated, and **clinical observations** have confirmed the assumptions advanced from its theoretical study.

As an illustration of the clinical advantages which may be anticipated from the use of this preparation, the following extracts,* together with comments, may be found interesting to the reader:—

* "The Oxygen Treatment," by John Aulde, M.D., in Medical Times, 1888.

"As there is an impression abroad that the use of oxygen in therapeutics requires special skill on the part of the physician, and that it involves a considerable outlay on the part of the patient, a few words as to the apparatus needed and the expense connected therewith may not be out of place in this connection. Unsatisfactory results, it is true, have attended the efforts of some, but chiefly for the reason that they have been contented with the use of ordinary commercial gas, compressed in iron or copper cylinders,—a method strongly condemned by Wallian, who believes that by this process the gas is to a certain extent devitalized. Observers are therefore cautioned that the best results will follow the use of the strictly nascent or fresh gas, which may be readily prepared, all impurities or deleterious elements being promptly eliminated by the process.

"For securing perfectly fresh oxygen, two sources are available. The most convenient and at the same time least expensive, when but a small quantity is required, is by means of a preparation of hydrogen dioxide (H_2O_2), commonly known as peroxide of hydrogen, which, on being moderately warmed, gives off one equivalent of its oxygen, and in a state so decidedly active as to strongly resemble ozone. Brunton says: 'It has therefore been used for similar purposes to ozone. It destroys bacteria and is a powerful antiseptic.' This is the method I have adopted for the most part, and, although the volume of gas realized is so small as to seem insignificant, it apparently makes up in quality or intensity for the lack in quantity. The other method, recently made available, is by means of a portable generator, which may safely be placed in the hands of the patient, or an intelligent nurse, the whole outfit not costing more than twenty-five dollars.

"When the peroxide of hydrogen is to be used, the patient is supplied with a bottle of the solution, generally employed in the strength of ten or fifteen volumes, in water, together with an inhaler, the use of which can be explained in a few minutes. A small portion of the dioxide solution is placed in the inhaler along with a little clean water, and heat applied; the evolution of oxygen soon follows, and the patient is permitted to practice inhalation from ten to fifteen minutes two or three times daily; or, in case the inhalation is found to be too laborious, five minutes or less will be sufficient, in which case it is advisable to increase the frequency of its administration. The method resolves itself into a pulmonary gymnasium, by which the patient is permitted to inhale pure, warm air, charged with oxygen, while carbonic acid, which ordinarily accumulates in the lungs and causes depression, is thrown off.

"A case, which may be mentioned, was that of a widow lady, aged thirty-five, who, two years previously, had buried her husband, his death

being due to phthisis pulmonalis. During all the time of his illness she had given him her personal attention, and when first seen there was a suspicion that she also had contracted the disease. Later observation, however, convinced me that I had to deal with a case of catarrhal pneumonia, chronic in character, although I was strongly impressed with the idea that it would ultimately become catarrhal phthisis. The cough was exceedingly intractable, with great depression of the vital powers. The sputa were thick and tenacious, the color and consistency indicating the breaking down of pulmonary tissue to such an extent that my prognosis could not be other than unfavorable. This information was kept a profound secret from the patient, but the relatives were fully advised as to the probable results of treatment. It may be mentioned here that for the preceding two years she had been under irregular treatment, and had been informed positively that she was going the same way as her husband, all of which, no doubt, added to her depression. The fact that she feared this to be the final result was about the only redeeming feature of the case, and I proceeded with the greatest deliberation. Suitable medication with a view to maintain the nutrition was regarded as of the first importance, and the use of the oxygen was attended to faithfully by both patient and nurses. At first, the inhalations could be continued for but a few minutes at a time, but in the course of a week she was able to take the treatment for the space of ten minutes, about four times daily.

"Soon after treatment was begun there was rebellion in the camp; the effort required proved rather depressing, and, besides, she had several serious attacks which threatened to terminate fatally. These attacks were characterized by great cardiac pain, dyspnœa, and a sense of choking or smothering, and I must confess that on several occasions the end seemed near at hand. They were followed, or rather accompanied, by profuse expectoration of muco-purulent clots of such size that I will not undertake to make any comparison, lest it should appear to be a gross exaggeration. In the course of a month or so, after she was able to sit up in bed, she questioned me very pointedly in regard to her prospects, and, while I was tempted to tell her what I considered her true condition, the belief that she would quickly succumb under an unfavorable prognosis prompted me to gloss the matter over, and she appeared greatly relieved. A week later she surprised me with the information that she was to be married, and that her engagement had been determined altogether on my prognosis. Here was a dilemma; but the mischief had been done, and it was then too late to retrench! She followed up the oxygen treatment for the period of two months in all, and was married shortly after treatment was discontinued.

"Nearly two years have now elapsed, and with the exception of one

attack of illness, which usually attends ladies soon after pregnancy takes place, she has enjoyed fairly good health. What the final outcome of the case will be I am not at present prepared to say, but certainly the prospects are far from bright. Want of space prevents me from giving any of the details of the system of medication which was carried out, but suffice it to say that the picture is not overdrawn, and I am fully convinced that the inhalation of the oxygen saved her life."*

In addition to the use of the dioxide as an inhalation, the **antiseptic properties** which it possesses are of such importance that it becomes an invaluable aid in the matter of **surgical practice.** As **compared** with other antiseptics it is claimed that the dioxide is forty per cent. more potent than mercuric bichloride, twenty times as powerful as salicylic acid, and sixty times the activity of carbolic acid; although as a germicide it is admitted to be less powerful than those drugs just mentioned, but its value in this direction is of no small merit. As a **disinfectant** we are warranted in taking into account the observations of Pasteur, from the fact that we are fully aware of the prevalence of micro-organisms in both medical and surgical practice.

The **topical uses** of this remedy will include the local use by means of the spray or otherwise in all such morbid conditions as gangrene, boils and carbuncles, indolent ulcers, and carcinoma; also it may be used locally in venereal diseases. Shelly,† speaking of the local use of the dioxide, says: "It is interesting to watch the action when a few drops of a proper solution is brought in direct contact with pus-corpuscles." A brisk effervescence at once commences and continues until all the **pus is destroyed**, and upon this basis he has suggested that it might be used for the detection of pus in the urine. Such qualities would naturally commend it to the attention of the gynæcologist, the ophthalmologist, and the laryngologist, and in many of the more serious diseases coming under the observation of the general practitioner, like **croup** and **diphtheria.** Acting as an enemy of the bacteria and enzymes, together with its destructive effect upon diseased tissues while the healthy membranes remain unaffected, and being perfectly harmless when swallowed, its use cannot be too strongly urged in the two latter affections. As an inhalation, a spray, douche, or gargle, or applied locally by means of absorbent cotton to the affected area, it will be found to produce an immediate and favorable action, and there need

* Referring to this case, July, 1889, it may be noted that the patient passed through the period of confinement and is now *enceinte* for the second time, and, at the end of three years after treatment, appears in better health than for many years. Illustrative cases of this character could be increased,—a fact which may account for the enthusiasm of the present article; but when one sees the dead brought to life, as it were, the disposition is but natural.

† Practitioner, London, 1884.

be no fears that harm will result from its frequent repetition. Nunn, of Savannah, Georgia, reports flattering results following the use of the peroxide of hydrogen in the treatment of diphtheria, and claims that when seen in the early stages much can be expected in the way of modifying the character of the disease and in curtailing the period of sickness, and, besides, he is credited with the assertion that **no fatal cases** have been met with since this plan was adopted. Richardson recommends an ethereal solution called "ozonic ether." In the treatment of **true croup,** where the breathing had become so embarrassed that cyanosis had begun, decidedly beneficial results followed the use of the spray diluted with a small quantity of warm water.

In **gynæcological practice,** a vaginal tampon may be prepared of absorbent cotton and introduced into a gelatin capsule along with a solution of the dioxide and a little glycerin with the best results. This preparation forms the **glycozone,** so called, but only perfectly pure glycerin should be used in this manner. The above-described tampon may be used to good advantage by simply saturating the cotton with the ordinary fifteen-volume solution; but in introducing the tampon the necessary pressure will have a tendency to remove the greater part of the preparation, while by the use of the capsule, which will readily dissolve, the solution may be placed in the desired position, when the patient should maintain the recumbent position until solution of the capsule has taken place and the affected parts have been bathed in the antiseptic solution.

Cases of **septic poisons** introduced into the system either from dissection or other wounds should be promptly submitted to the influence of the dioxide; if pus has already accumulated an exit must be made for it, and the remedy applied until all symptoms of effervescence have subsided. In the treatment of **pyæmia** it has been highly recommended.

A word may be added from a **theoretical** stand-point regarding the method of using this preparation in the treatment of **yellow fever** and **cholera,** and are in the main conclusions which have been formed from the preparation of the preceding pages. If we are willing to admit that this remedy has such an action upon tissue-change, bacteria, enzymes, and upon morbid products as pointed out, we are warranted in assuming that it would be an efficient agent in controlling or destroying the poisons found in the alimentary tract in the diseases named; and as the greatest difficulty heretofore has been in bringing the antiseptic within reach of the habitat of the poison, this obstacle will be fully overcome by the use of the remedy by rectal insufflation. We have already mentioned the fact that the use of the oxygen gas has been recommended in the form of rectal insufflation, and by the method suggested in the treatment of

cholera and yellow fever the circumstances would all seem to favor the action of the preparation. Demarquay has used it in many **chronic diseases,** and has also found it a valuable aid in **surgical practice.** Patients subjected to severe surgical operations endured the ensuing shock, depression, and loss of blood much better for having been previously superoxygenated. He also applied local **oxygen baths** to patients suffering from foul ulcers and gangrenous wounds of the extremities, and reports excellent results in these cases, the wounds rapidly taking on a healthy appearance and losing their fetid and angry character.

In concluding this somewhat imperfect sketch the authors realize that there is still much that might be said, but an attempt has been made in the hopes of bringing the main points to the notice of the reader, and sufficient has been said to enable the intelligent practitioner to determine for himself the cases in which the remedy might be used with the reasonable hope of success; and it is believed that the present is but the infancy of the therapeutical uses for oxygen, and, like electrotherapy, we predict for it a brilliant future.

NITROGEN MONOXIDE.

Nitrogen monoxide (N_2O) (Protoxide), better known as nitrous oxide or "laughing gas," is a preparation more generally used for the purpose of producing temporary anæsthesia or exhilaration according to the mode of its administration. When inhaled in an undiluted form it causes rapid anæsthesia, sufficient for minor surgical operations, but when taken with an admixture of atmospheric air the action is that of an exhilarant.

It is **prepared** from nitrate of ammonium by the action of heat.

Administration, as stated, is generally by inhalation, but of late years, as will be noted further on, it has been used locally in connection with the hydrogen dioxide. As generally used by dentists it is condensed and placed in an iron receiver, and by means of a suitable mask or mouthpiece connected with the container by a rubber tube the gas is conveyed to the patient.

PHARMACOLOGY.—When but a small quantity of the gas has been inhaled the subject undergoes a period of excitement which lasts but a few moments, but during that time he displays the effect it has produced in a variety of ways. Some will sing, dance, laugh, or talk volubly, while at other times a pugnacious disposition will be developed; a peculiarity of this is that the subject is fully aware of the ludicrous appearance he is making, but yet feels no disposition to control his antics. This, however, is not noticeable after the full effect has been produced, when the influence of the remedy is wearing off. As a rule, **no bad effects**

follow its administration, and the patient soon recovers full consciousness, although we have seen several cases in which the effects failed to disappear within several days; but this in all probability resulted from some impurity in the gas. Such accidents are not likely to occur, from the fact that the preparation does not readily undergo decomposition, and is more stable than any of the other gases we have mentioned in this article.

The **general action** is principally through the nerve-centres, which are deprived of oxygen, but it is not definitely known just what decomposition takes place when it is introduced into the economy, although its anæsthetic effect is similar to that of nitrogen. The effect upon the **blood** is to cause it to assume the venous hue, and for this reason it is not well adapted for continued anæsthesia,—an observation which may appear somewhat anomalous when the statement is made that it readily parts with its oxygen, and will support combustion equally as well as oxygen itself.

THERAPY.—The claim is advanced that it is nitrogen monoxide instead of oxygen which is largely used by irregular practitioners at the present time, and, while it may act as a sedative and exhilarant, equal benefits cannot be claimed for it from a therapeutical stand-point. A **combination** of the two, however, may be made to advantage in those cases where oxygen would be too stimulating, or when the anæsthetic effect is desired, and this is now a method of treatment **approved** by those who have given the subject careful attention, who have reason to believe that in addition to the influences just mentioned it assists materially in the distribution of the oxygen. For this purpose from 15 to 50 per cent. of the entire volume of the gas may be nitrous oxide, the balance pure oxygen, and this compound is diluted by the admixture of atmospheric air during inhalation.

Minor **surgical operations** which require but a short time for their performance may be submitted to under the influence of this gas, and it is now largely used by dentists when extracting teeth. As **compared** with **chloroform** for this purpose, the nitrous oxide is greatly to be preferred owing to the danger attending the use of chloroform when the operation is small and requires but a meagre quantity of the anæsthetic, and when given while the patient is in the erect position. The accidents reported from this have been so numerous within late years that the use of chloroform for this purpose should be discouraged. When compared with the action of **ether,** we may note that the action of the nitrous oxide is much more rapid than the former, and, besides, there is not the disagreeable odor about it which is so offensive and at the same time so formidable to some persons; recovery from its effect is also much more

rapid. When a formidable operation is contemplated the use of nitrogen monoxide, it is believed, will not only bring the patient more quickly under the influence of the operator, when given as a preliminary to the administration of ether, but it has the effect of inspiring confidence on the part of the patient; and it has been observed that, when given as a **preliminary to ether** in these cases, the recovery of the patient from the effects of the anæsthetic is more prompt and complete. A note should be added to the effect that, after the administration of this gas, it is well to ask the patient to perform some simple manual effort, by which consciousnes is more quickly regained.

The **analgesic** properties of the gas render its use of great service as a topical application in connection with the local use of hydrogen dioxide, to which the reader is referred in the preceding pages. The same may be added relative to its use in combination with oxygen gas or with hydrogen dioxide in the form of enemata, in all cases where the use of either is demanded, and where the sedative and anæsthetic action of the protoxide is indicated.

OZONE.

Ozone is a colorless gas, having an unpleasant odor, and is not readily soluble in water, one hundred volumes taking up but .5 volume. It is supposed to **differ** from oxygen in having the three molecules condensed into one (O_3), and this was apparently demonstrated by the experiments of Sir Benjamin Brodie in attempts to ozonize oxygen, when it was discovered that not more than 15 per cent. of this gas could be converted into ozone. This was due to the facts connected with what is called dissociation phenomena, by which reconversion takes place.

When an electric spark is passed through the air a peculiar smell is noticeable, and is due to the breaking up of oxygen and the **formation of ozone.** It may be obtained from oxygen by various forms of apparatus, generally constructed on the principle of Siemens's induction-tube, although it has never been obtained in a pure state. In slow oxidations ozone is generally found, and probably in most cases is accompanied by that of hydrogen dioxide, to which it has been compared, and by some is considered identical, although there is a consensus of opinion that it shall be admitted to be an **allotropic** form of oxygen. **Traces** of ozone are found in the open country, and its value becomes of significance from the fact that it favors the removal of organic impurities from the atmosphere by destroying them. Ozone may again be converted into oxygen, slight decomposition taking place at 110° C.; 97 per cent. is reconverted at 200° C.; and the entire volume at less than 300° C.

The action of ozone upon **albumin** is, to say the least, remarkable,

and consists in rendering it uncoagulable by boiling and the addition of acids, unless they be added in large quantities, although, on the other hand, the addition of alkaloids retards its coagulability, and these substances also seem to destroy its affinity for oxygen.

The study of the **oxidation** of phosphorus is an exceedingly interesting matter, and should be referred to. In undergoing oxidation **phosphorus** breaks up the atom of oxygen; one goes to the phosphorus and the other unites with two more to form ozone, and here again are probably illustrated the phenomena of dissociation, could we trace reactions. **Protoplasm** also possesses the power of causing rapid oxidation, and it has been suggested that this action is similar to that of phosphorus.

PHARMACOLOGY AND THERAPY.—Ozone has an irritating effect upon the respiratory apparatus, and probably the great value of ozone lies in its oxidizing power. Dry mercury is promptly oxidized by it, although oxygen has no effect upon it; dry iodine also is oxidized, and so is indigo, and, with the exception of paraffin, which it does not affect, nearly all organic substances are quickly destroyed by its action. Binz, who has given the subject a great deal of attention, is a believer in the **soporific** effects of ozone, although on the tissues it diminishes, instead of increasing, oxidation. The brain, like respiration, is variously affected, probably according to the amount taken into the system. The power of this agent over low forms of organisms would indicate its employment in all forms of **infectious** and **contagious diseases**, but in order to do this we must first learn to handle it with safety to ourselves. While the therapeutic value of the gas is not yet up to the prophesies of those who have studied the matter, the time is doubtless near at hand when we may be able to control this agent just as well as many others which are now in common use.

HYDRO-THERAPEUTICS.

GENERAL CONSIDERATIONS.—Water is an integral portion of the human economy, entering into the composition of every tissue. The digestive fluids contain a large proportion of water, and the essential part of the process of **digestion** consists in the solution of the various solid constituents of our food. After solution has been accomplished the fluid pabulum is capable of being absorbed by the lacteals and blood-vessels, and distributed by the latter throughout the organism. Entering into the composition of every organ, tissue, and secretion, being a necessary factor in all the processes connected with **nutrition**, those of elimination, as well as those of absorption, it is manifest that water must be regarded as a true **aliment.**

Again, since its presence is necessary to the performance of every kind of **cell-life,** it is not only imbibed in the work of constructive, but is also produced in that of destructive metamorphosis. A sufficient quantity of water must be regarded as necessary to the **healthy action** of the excretory no less than to that of the secretory organs.

As it escapes from the system it carries with it, in solution or suspension, a large number of inorganic or organic compounds, **waste products** which have resulted from the breaking down of tissue. This property renders it depurative.

It possesses a true **diuretic** action, since it increases not only the water of the urine, but also urea, sulphuric acid, phosphoric acid, and chloride of sodium, the increase of the latter ingredient, however, being but temporary. Water promotes **free alvine discharges,** but the solid constituents of the fæces are not increased. A deficiency of water in the contents of the large intestine is attended by troublesome or even serious effects. From seven to eleven ounces of watery vapor is daily thrown off by the **lungs,** and this vapor, also, removes, in addition to carbonic acid, inorganic and organic **substances** from the system.

The **hygienic** effect of mere cleanliness can scarcely be overestimated. Impurities are removed from the integument, and obstruction of the ducts by inspissated or altered secretions is prevented. Thus the cutaneous envelope is rendered capable of performing most perfectly its important respiratory and secretory functions. The reflex consequences upon circulation and innervation tend to promote the health of the system at large. The hygienic and therapeutic effects of water when applied externally depend largely upon its temperature. It is the most suitable vehicle by which the human body may be subjected to the varying action of different degrees of heat. In addition, however, to the influences due **to temperature,** the direct and reflex impressions produced by the mass of water, together with the cutaneous absorption, must be taken into account. Immersion in a bath at 95° F. for the period of half an hour has been found to add eight ounces to the body-weight. The use of water of moderate temperature is not, however, attended by such positive consequences as when it varies considerably from that of the surface.

THE DIFFERENT KINDS OF BATHS.—A bath may be general or partial; simple immersion may be practiced, or the effects may be variously modified by the alternating impression of heat and cold, by the effect of sudden impact of different grades of force, as in affusions, douches, or shower-baths. We may also avail ourselves of the different physical conditions which water may assume, so that the effect of **vapor baths** and of the local employment of ice are properly discussed under the head of Hydro-Therapeutics. One of the most powerful modes of

influencing bodily states by means of water is the ocean, or surf bath. Water may also be used as an injection in order to fulfill various indications.

At a **moderate temperature** (75° to 85° F.) water produces upon the human system no decided effect, either stimulant or depressant. It subserves the purposes of cleanliness, and the physiological and hygienic results which are connected with that condition. Its **therapeutical** application is restricted to irrigation of wounds or ulcerated surfaces for the purpose of removing blood, coagula, pus, tissue *débris*, or foreign bodies. The influence of a **tepid** bath is scarcely more pronounced, but, as the temperature is raised from 85° to 95° F., is gradually merged into that of the **warm bath**, the heat of which ranges from 95° to 100° F., while from 100° to 105° F. we obtain what is termed the **hot bath.**

The **surf bath** may be regarded as the **type** of the cold bath. It causes the most active **tissue change**; perspiration is first checked, but subsequently increased; the excretion of urea is promoted. The primary shock and depression, quickly succeeded by an exhilarating reaction, the freedom of movement, the impact of the tumbling waves, the exercise of swimming, the stimulus of gay society. the simultaneous influence of sea-air, sunlight, and the spectacle of the boundless ocean, produce in perfection the beneficial results of bathing in cold water. These benefits accrue if the bath be left early, but if it be unduly prolonged surf bathing becomes **positively injurious.** There are some persons of tolerable health but delicate physique to whom surf bathing is never advantageous. The **shock** is too severe and **reaction** tardy or absent. For such, warm sea **baths** are provided at the sea-side resorts. Robust individuals are greatly benefited by ocean baths, provided they act with discretion and leave the water before depression occurs.

EFFECTS OF BATHS.—The **effects** produced by baths are partly of a **direct** and partly of a **reflex** nature. Either hot or cold water exerts, in the first place, a purely physical action in communicating or abstracting heat. The impression produced by warm water upon the sensory nerve-filaments at the surface is reflected by the vasomotor centres; the cutaneous vessels dilate, and are filled with a greater volume of blood, which fluid is, to a corresponding extent, withdrawn from the interior of the body. **Radiation** of heat from these distended vessels leads, subsequently, to reduction of **temperature.** When directly applied a high degree of heat causes coagulation of albumin and contraction of blood-vessels, and this contraction lasts for a considerable period.

The **first effect** of a cold bath is, upon purely physical principles, to **abstract heat** from the surface. Together with this effect the blood-vessels are caused to contract, leaving the surface comparatively blood-

less, and concentrating the circulating fluid in the internal organs. **Reaction,** however, impels it to the periphery. The afflux of blood acts, in its turn, upon the sensory end-organs, and a luxurious sensation of warmth replaces the chill. Other results are produced coincidently upon respiration and circulation, and, snbsequently, upon glandular and muscular activity, and nutritive processes in general. If reaction is not prompt, it may be promoted by **friction** of the entire body during the bath.

A **summary** of the facts stated leads to the conclusion that the first effect of a general **cold bath** is depressant; during the stage of reaction a tonic influence is generated; after the reactionary stage has subsided a depressed condition follows, which lasts for a considerable period. Moderate **heat** is sedative. A **hot bath** is, for a short time, stimulant, but if too prolonged it becomes powerfully depressant.

A **corollary** from this *résumé* is that both in health and disease it is exceedingly important that a bath should be so managed as to derive its beneficial and avoid its prejudicial effects. The same agent which, rightly used, is effective for good, is proportionately effective for evil when abused. This is true of every powerful hygienic measure or therapeutic remedy.

A certain **modification** of the influence of baths takes place in **disease.** In many cases the most pressing problem relates to the communication or withdrawal of heat. The continual loss of heat and reduction of temperature at the surface favorably modifies the process of **heat production** within; heart and brain are preserved from the damage incident to elevation of temperature. But these questions will be studied more in detail when we come to speak of the application of water in the treatment of disease.

Water may be **used externally** in a great variety of modes. It may be brought into contact with the entire surface of the body, constituting a **general bath,** or may be applied to a restricted portion, forming a **local bath.** The terms foot-bath and hip-bath substantially explain themselves. A **sponge-bath** is taken by causing water to trickle over a portion or the whole of the body, by squeezing a sponge which is distended with water; it may, therefore, be either local or general. The same is true of **affusions,** which consist in the dashing of water with more or less force against the body. The mass may be directed from above, from below, or horizontally. The **shower-bath** is analogous to affusion. In the former the stream is divided into a number of drops which fall from a height upon the head, neck, and shoulders of the bather. The shower-bath is usually taken in connection with the general bath. When a stream of water is blown into **fine spray,** it is said to be atomized, and the spray is a valuable application to the respiratory surfaces. A constant stream caused to impinge upon a surface is called a **douche.** It makes a

powerful impression upon the capillary circulation, and also upon the absorbent vessels.

Another way in which water is used is the **wet-pack,** to be hereafter described. Water may also be charged with electricity, and thus a **water** and **electric** treatment may be **combined.**

The influence upon the circulation, secretions, and respiration of the skin, upon its sensory nerve-fibres, the reflection of this influence to all parts of the system, the gentle muscular exercise, the improvement of all the forces of life, is sufficiently attested by the **pleasurable sensations** which accompany and succeed a bath, provided that the requirements as to its temperature and duration be properly observed.

Many, who are scarcely to be ranked as invalids, lack sufficient vigor to react from the cold bath. These, consequently, experience only its evil effects, and it is a mistake little short of cruelty to encourage cold bathing on the part of such persons. On the other hand, robust individuals, in whom reaction rapidly succeeds the chill, derive enhanced force from the cold bath.

The **most important** effect of baths is, perhaps, to be ascribed to the influence of **temperature,** water serving only as a medium. Nevertheless, the physical contact of the fluid, the impact due to plunge, shower, or surf bath are subsidiary factors in the production of the result. Nor do we consider the absorption of fluid as entirely without importance. That absorption takes place has been doubted or even denied, but a gain in weight and the experience of shipwrecked mariners prove that it does occur. The organic and saline substances held in solution in the bath may not be able to pass through the skin in appreciable quantity, since they have not been detected in the excretions.

At the present day, most hydropathic establishments, as they are called, are under the superintendence of a physician, who should be able to determine to what cases the water treatment is adapted. A **visionary system** of pathology is connected with hydropathy as a plan of treatment. This may be disregarded, however, and need not prevent scientific medicine from obtaining all the information possible from the empirical experiments of hydropathy.

MODERN METHODS.—It will often happen that a patient in whose case a Turkish bath is likely to prove beneficial is unable to seek a public establishment. In such event a **domestic substitute** may be devised by placing the patient naked upon a cane-seated chair, covering him with blankets, with the exception of the head, a spirit-lamp being lighted beneath the chair. As adjuvants water may be drunk freely and a pan of water placed above the lamp. In ten or fifteen minutes a copious perspiration is excited. When this has reached its height the

blankets are removed and cold water dashed upon the body or the patient may enter a moderately cold general bath.

A **vapor bath** may be easily procured when the patient is too ill to leave the bed. Two or three hot bricks wrapped in moistened flannel laid under the bed-clothing soon produce an abundant outbreak of perspiration. After fifteen minutes the moisture is rapidly rubbed off with a towel wrung out in cold water. After that he is rubbed dry and the bed-linen is changed. Such a steam bath is of undoubted efficacy in acute articular **rheumatism.**

Still **another** mode in which the system is subjected to the influence of water is by means of the spinal ice-bag and spinal hot-water bag introduced by Dr. Chapman. The **application of cold** over the spinal **column,** Dr. Chapman asserts, influences the condition of the vasomotor centres, and, consequently, the circulation in different parts of the body. The centres are partially paralyzed, and the vessels which derive their animation from the affected centres dilate and receive an increased quantity of blood. Muscular **spasm** is relieved, sensibility is lessened, and hypersecretion checked. Through its effects upon the peripheral circulation the bodily heat is increased. Applied over the lower dorsal and lumbar vertebræ, an increased determination of blood to the pelvic organs takes place. This promotes **menstruation,** or **restores** the function when it has been suppressed. For the same reason it restores warmth to **cold feet.**

Conversely, a bag of **hot water** applied over the vertebræ will stimulate the peripheral vessels to contraction. Dr. Chapman states that by this device he has been able to **arrest hæmorrhage** from the nose, the lungs, or the womb. To affect the nose and lungs the bag should be applied over the cervical and upper dorsal vertebræ, to act upon the uterus over the lower dorsal and lumbar vertebræ.

THERAPEUTICS.—In deciding to make use of water as a **therapeutic agent** it is necessary to choose which mode of application and what temperature seem best calculated to act advantageously. Accidental circumstances, such as the surroundings of the patient, the efficiency of the nurse, etc., must be taken into consideration. And as regards the temperature at which the water shall be employed it must be confessed that **no absolute rule** can be formulated. **Cold** will sometimes succeed when **hot** seems indicated, or the **reverse** may be the case. This is to be accounted for partly by the fact of different individual nervous susceptibility and partly by that of the different effects of temperature according to the length of time spent in the bath. Therefore, at certain stages, the effects of **hot** and **cold** water are, to some extent, **interchangeable.** As a rule, however, those affections which are attended by elevation of temperature are benefited by cold, while those which are marked

by depression of temperature and strength are improved by hot applications.

Surf bathing creates a profound impression. We are greatly more susceptible to the temperature of water than to that of the air. Water at 70° F. gives rise to a decided sensation of cold, whereas the atmosphere at the same degree is felt as warm. At the same temperature, also, running water seems colder than that which is at rest. The **waves** strike with considerable force. **Exercise** during bathing soon causes **fatigue.** These circumstances account for the shock and depression produced by the sea bath. In the vigorous this shock is succeeded by a proportionate reaction, and the system is strengthened. But if, from any defect whatever, reaction does not occur, the bath becomes a **source of injury** and should be forbidden. It is **particularly beneficial** to individuals of naturally robust constitution, but who have been debilitated by arduous mental labors and excitements, exhausted by the requirements and surroundings of city life, or to those whose habitual occupation is of a sedentary or unhealthy character.

Sea bathing may also be advantageous to those who have not long recovered from some prostrating disease. In **chronic phthisis,** especially of the **fibroid** variety, it may also prove invigorating. **Pregnant women,** who have previously aborted, should never enter surf, but a woman who has never met with this accident, and has been accustomed to sea bathing need not debar herself from the habit. It is inadvisable for a woman to begin a course of bathing during the catamenial flow; otherwise the baths need not be intermitted.

The **best time** of the day to indulge in the sea bath is about **eleven o'clock** in the morning. At that time breakfast has been digested, or nearly so, and the economy stands in no present need of food. It is improper to bathe during digestion, since nervous energy is engaged in presiding over the elaboration of food.

The grand **indication** for the employment of **cold-water baths** is elevation of temperature. The higher the temperature, the greater the need of frequent applications. A high degree of **fever** leads to rapid degeneration of tissue; the most **vital functions** of the organism are perverted; muscular tissue undergoes granular and fatty change; the voluntary muscles, the heart, and the muscular coat of the blood-vessels being especially affected. A similar alteration takes place in the structure of the **liver** and the **kidneys.** Waste elements accumulate in the blood, which becomes rather a toxic than a nutrient fluid. The oxygen-carrying function of the red corpuscles themselves is seriously impaired. The structure and functions of the central nervous system share in the general disorder. The secretions are well-nigh suppressed. It is evident

that **life cannot** long **endure** such a strain. Life is directly menaced by any temperature above 105°, while recovery may almost be reckoned a physical impossibility when the mercury ascends above 108°.

The most **effective,** the most **prompt,** and the **safest** means of combating these serious results of **hyperpyrexia** is by the general cold bath. In febrile conditions, by reducing temperature it lessens the waste of tissue which the fever has occasioned. Cold water is not able to abort the course of a **specific fever,** but it conserves tissue and force, relieves the most urgent and dangerous symptoms, quiets restlessness, lightens the cerebral symptoms, and effects a notable decrease in the death-rate.

In **cerebro-spinal fever** the intense pain in the head, back, and abdomen; the cramp, stiffness, and convulsive twitchings in the muscles; the hyperæsthesia, the active delirium of the early stage are relieved by the cold bath. The alarming symptoms are replaced by quiet or sleep, and much **damage** to spinal cord and brain is **averted. Measles** is a disease which, as a rule, does not demand energetic treatment, yet in a not inconsiderable proportion of cases it assumes a grave form, characterized by high fever, hæmorrhages, and brain trouble. In the milder variety sponging with cool or cold water, and in the more severe the application of cold cloths, the wet-pack, or the general bath are measures which should be adopted. **Scarlatina** is generally a dangerous disease. In the beginning it is attended by high fever, and the dangers which belong to that condition; even when the initial fever is not intense, we have to contend with the subsequent peril of acute nephritis. With the fever we generally have to deal with extreme restlessness and headache, sometimes even convulsions, or a semi-comatose condition. In order to reduce to a minimum the dangers due to the temperature, irrespective of its cause, the cold-water treatment is **eminently suitable** to the early days of scarlatina. Especially is this true of those cases, not few in number, in which the thermometer registers **more than 103°.**

A **good method** of employing the water treatment is that adopted by Ziemssen, who has the patient placed in a bath the temperature of which is 90°; this is gradually reduced by the addition of cold water until it has fallen to 77°. The length of **time** during which the patient should remain immersed depends upon circumstances. Occasionally he will feel chilled, and the circulation will be weakened, when he should be immediately removed and stimulated by warm covers and whisky or brandy. A reduction of 2° or 3° is generally effected by such a bath, which can be **repeated** when the temperature again rises to a threatening height.

If the general bath is impracticable, **substitutes** may be employed. One of the best of these is the cold wet-pack. This is administered by protecting the mattress of the bed upon which the patient lies by a

rubber cloth. A sheet which has been wrung out in cold water is then drawn under the patient and the sides folded over or firmly tucked under the patient. The wet sheet may be placed in position by attaching its edges to those of the dry sheet and withdrawing the latter. The wet sheet is thus brought into position without disturbing the invalid, and may be adjusted in the manner described. When heat, instead of cold, is indicated, the sheet may be dipped into warm water. The heat emitted by the fevered body soon vaporises the water, and an abundant perspiration is induced. The **packing** may be **renewed** at intervals either by changing the sheet or by sprinkling water upon it. Instead of being merely dampened with water the sheet may be saturated. This procedure gives relief to the sufferer, retards and strengthens the pulse.

Another method of administering cold water with excellent effect is termed **affusion.** This is performed by dashing with some force against the naked body large quantities of cold water, to the extent altogether of several gallons. A notable reduction of temperature is occasioned by this practice. A cloth or towel which has been dipped into cold water may be laid upon the abdomen, breast, or thighs, and in the armpits, and the moisture renewed as soon as the cloth becomes dry. Or the body may be frequently **sponged** with cold water.

Cold applications are especially called for in **malignant scarlatina**, in which high temperature, anomalous rash, and hæmorrhages proclaim the toxic quality of the blood. Cold compresses and sponging assuage discomfort, but produce little reduction of temperature. When the fever is active, the pulse bounding, the restlessness, headache, or delirium extreme, the cold bath, affusions, or the cold wet-pack are the measures to which we should promptly resort. All that has been said of the value of water used externally in scarlatina applies, with perhaps increased force, to **variola.** The first stage of this loathsome complaint is marked by considerable fever, intense headache and backache, and often by delirium. Cold applications, therefore, are not inappropriate at this stage. The wet sheet may be preferred at this period on account of the reaction and sweating. It is, however, during the **secondary fever,** that accompanying maturation of the pocks, and in **confluent small-pox,** that water is particularly indicated. If it accomplished no other purpose than irrigation of an immense suppurating area, such an application would confer **great benefit.** The additional danger of purulent absorption is removed. Much more, however, is accomplished. The removal of the pus and the scabs limits the suppurative process. The tendency of this is to **lessen the pitting.** The stomach is enabled to perform its functions measurably, and less emaciation and debility are produced by the attack.

Typhoid fever is, beyond all doubt, the disease to which cold-water

treatment is **especially applicable.** Its universal prevalence, its duration, the height to which the temperature often mounts, its remarkable prostrating effects, as well on account of its influence upon the nervous centres as of the degeneration of the heart and voluntary muscles, are circumstances which recommend the **strongest antipyretic** measures within our power. In typhoid fever, to reduce temperature is to **save strength,** and to save strength is the grand indication. Every remedy is employed with this end in view. If we are able to carry our patients on to that time when, according to the natural history of the disease, defervescence takes place, life may, as a rule, be saved.

Currie employed cold **affusions** in the treatment of typhoid fever, and for twenty or thirty years, by reason of his strong advocacy, this measure was extensively resorted to in Great Britain. It then fell into a strange neglect, and has but lately been revived, owing to the testimony of German physicians in its favor. In 1861 Brand, of Stettin, published a work called the "Hydro-Therapy of Typhoid Fever," in which he narrated his **success** in the use of this treatment. Cold water has since been very largely employed in Germany and Switzerland by Bartels, Jürgenssen, Ziemssen, and Liebermeister. The attention of English-speaking physicians was drawn anew to the subject by Dr. Wilson Fox.

As regards the **mode** in which the treatment should be executed, we can but repeat what was said of the hydro-therapeutics of scarlatina. Some have preferred **cold,** others baths in which the temperature is **graduated.** By some **affusions** have been employed, while by others **cold towels,** the **wet-pack,** or **cold sponging** have been brought into requisition. There is no doubt that typhoid fever varies extremely in the severity and even the duration of the attack. Some cases are so mild that no urgent symptoms are exhibited. There is present only a continued fever without much disorder of the bowels or pain, without marked cerebral symptoms, perhaps not even delirium. The strength is tolerably preserved, and every sign and symptom point to ultimate recovery. In such cases, hydro-therapeutics, like every other form of treatment, has but an insignificant rôle to perform. Cold sponging or cold cloths are perhaps grateful to the sufferer, and may, therefore, be employed. But a **well-marked** case runs quite a different course. The prolonged high temperature manifests itself in the dry, parched skin, the utter prostration, the subsultus tendinum, the delirium, the coma vigil ; these are the cases emphatically that **require cold** applications.

Brand and others have, in addition to the general bath, made use of the **shower-bath** and **affusions.** These, however, seem rude applications to patients too ill to raise the head ; moreover, they are much **less efficient** than the general bath. There are **two methods** of employing the

bath; that of Liebermeister is by **abrupt** immersion in water of the temperature of 68°. The shock of contact is soon succeeded by a return of the circulation to the cutaneous capillaries, and a sensation of comfort ensues. If no contra-indication forbid, the patient is allowed to remain in the water for ten minutes. He is then wrapped in a dry sheet and returned to bed. If reaction is not good the stay in the bath is reduced to seven, or even to five minutes. If the circulation still appear depressed alcoholic stimulus should be used and hot bottles placed in the bed. For very weak or very nervous patients the method of Ziemssen is preferable. This consists in the use of the **graduated bath,** in which the patient is placed in water at the temperature of 95°, which is gradually lowered to 77° by the addition of cold water. In a bath of the latter description most individuals may remain half an hour without discomfort or danger. Administered in either manner the general cold bath causes the mercury to fall 2° to 2½°. This fall continues for a little while after removal from the water, so that it is unnecessary to use the thermometer while the patient is immersed.

Preyer and Flasher proposed, in 1884, the use of the spray instead of the general bath. The patient need not be removed from bed. The covers are laid aside, the mattress and sheet protected by rubber cloth. A finely divided spray is then directed upon the body for about half an hour at a time. The operation may be repeated as often as necessary. Water of any temperature may be employed, according to the indications. Placzek uses about a pint and a half, from 53° to 59° F., after which he resorts to water of a higher temperature.

The **depression of temperature** is of variable duration; heat has been **dissipated** by a refrigeration of the surface, but the cause has not been touched. The production of heat still goes on, and the temperature, therefore, again begins to rise. The thermometer must consequently be used at frequent intervals. In **severe cases** the temperature at the end of two hours may be as high as before the bath. Immersion should then be repeated. In less urgent cases the bath need not be repeated oftener than every four or six hours. It is asserted that one general bath is equivalent to four successive packings with the wet sheet as regards the reduction of temperature.

Cold baths have been **opposed** as a mode of treatment in **typhoid fever** on the ground that they increase the congestions and inflammations of internal organs, and, therefore, the meteorism, diarrhœa, and tendency to hæmorrhage. It is probable that there is an increased liability to hæmorrhage. Yet this danger is by no means so immediate or so certain as is that of fatal exhaustion from high temperature. Brand makes the contrary assertion that this treatment lessens hæmorrhage and diarrhœa.

Professor Fuerbringer, of Berlin, esteems the bath valuable in the treatment of typhoid fever, less on account of its antipyretic virtue than by reason of its restorative effect upon the nervous system and promotion of nutrition.

Hydro-therapeutics is applicable to **typhus** in the same manner as to typhoid fever.

It must be confessed that the **utility** of the treatment by cold water has been greatly **limited** in consequence of popular **prejudices.** This particularly applies to the **exanthemata.** It has grown into an article of faith among the laity that efflorescence is promoted by a warm room, warm drinks, and abundant bed-clothes. This is a **survival** of what was taught by the medical profession a generation or two ago. People should be gradually **educated** to the opposite view, and success in the application of the treatment is the most effectual means of producing this change.

There is a condition which is apt to arise suddenly in the course of several disorders,—typhoid fever and delirium tremens, for instance,—but is especially liable to occur in acute inflammatory rheumatism. The case may be apparently progressing with no more than the usual joint involvement and pain when, without any warning or assignable cause, the **temperature** leaps to **110°** or even higher. Restlessness and delirium are followed by stupor, which deepens into coma, the pulse becomes frequent and forcible, the respiration hurried and shallow. The use of cold baths, of cloths wet with iced water, or even rubbing with ice, constitutes the only form of treatment by which this alarming condition can be overcome. The **wonderful** alleviation produced by cold applications will never be forgotten by one who has witnessed it.

Fevers of **septic** or **pyæmic** origin are also mitigated by the use of cold water. When the source of infection is accessible the diseased surface or cavity should be flooded. Benefit undoubtedly results from the removal of **infectious products.** We have, indeed, in this class of diseases, to combat prostration rather than high temperature, yet a high degree of fever is not uncommonly attained, and adds its own effects to those produced by the state of the blood and tissues. Our most promising means of treating these serious disorders consists in the removal of the nidus of infection and the dissipation of the heat, together with vigorous stimulation.

If **infection** be derived from decomposing material retained within the uterus of a puerperal woman **intra-uterine irrigation** should be practiced. The interior of the womb should be, as far as possible, cleansed and kept cleansed of infecting material. **Cold water** should be used externally either by means of Kibbie's cot or coils of metal or rubber, through which is kept running a **constant stream.** The latter application

is, as a rule, grateful to the patient's feelings and effects a considerable diminution of the temperature.

In fever **symptomatic** of inflammation, cold-water applications are also of service. When localized pain, heat, swelling, and redness point to a focus of inflammation, cloths wrung out in cold water will not infrequently prevent the formation of a **furuncle** or **abscess.** Cold towels to the chest diminish the pain of **pleurisy** and **pneumonia** and reduce inflammatory action. The **wet-pack** may be employed instead of the towel, and, in fact, is a **better** application. The same plan is useful in **pulmonary hæmorrhage,** though in this condition **ice-bags** to the chest are **preferable.**

It has been demonstrated that cold applications are useful in acute **articular rheumatism,** allaying the inflammation and pain in the affected joints and affording great relief to the sufferer. The water may be applied in several ways. Wet cloths may be wrapped around the swollen joints. The cold wet-pack, however, furnishes a better mode.

The profound influence of the general cold bath has been taken advantage of in cases of **maniacal delirium,** whether this arises from cerebral disorder or occurs in the progress of an acute fever, a typhoid fever, small-pox, etc. The same mental excitement sometimes presents itself in **acute alcoholism,** when the same treatment will be found effectual. In **puerperal mania,** also, this form of treatment has been used with **excellent results.**

Cold water may be brought into contact with the surface in a number of different ways other than by means of the general bath. This fact has, indeed, been incidentally anticipated in the foregoing description. Instances continually occur in which, although the general cold bath is **rationally indicated,** circumstances or prejudice preclude its employment. Recourse must, therefore, be had to one of the **local** or **partial** applications of hydro-therapeutics.

The **wet-pack** ranks **next** in **value** to the bath. Its antipyretic powers have already been dwelt upon at sufficient length. We may simply add, in this place, that in certain cases it possesses an **advantage** above the bath. This is where weakly, nervous, or emotional subjects, especially women, are concerned. Among persons of this type, and among children, much less objection, nervous shrinking, or excitement is caused by the wet-pack than by the general bath. The first contact is not productive of much chill and the heat of the body is soon communicated to the sheet. So much is this the case that the latter needs to be dampened with cold water from time to time, or it becomes, in effect, a fomentation. The sight of a bath-tub will often arouse violent paroxysms of excitement in children. In this contingency it is better to resort to the wet sheet. After it has been experienced once or twice it is seldom that it

meets with further opposition. It is, in fact, generally welcomed, for it is a very **refreshing** application.

A man who comes home fatigued at night with the toil and strife of the day will find himself remarkably freshened if he remove all his clothing and have himself wrapped in a wet sheet. The **enterocolitis** of infancy, which is either caused directly or, at least, maintained by excessive heat, is alleviated by the wet-pack. The discharges and fever are lessened, the gastric disturbance quieted, and alimentation is rendered possible. This treatment should always be adopted. Supplemented by removal to the sea-shore or mountains, or even to the pure air of a country place at some distance from the city, it has saved many a life. The wet-pack is a valuable measure in acute **articular rheumatism.** Practiced in the manner detailed above, it does not involve painful disturbance of position in the patient. The free perspiration evoked proves alike **grateful** to the feelings and **beneficial** to the disease.

Cursory reference has been made to **cold affusion.** This was a favorite method with Currie and has never been **wholly** abandoned, although its use has been curtailed. The bath has been gradually substituted for affusion in fevers. Nevertheless, Trousseau esteemed it highly in the treatment of **scarlatina.** In **sthenic cases,** with high temperature, he was wont to have the patient placed in a bath-tub and **splashed** with water by the **pailful** for a quarter of a minute to a minute. He was then removed to bed and covered with the bed-clothes without drying. Liebermeister approves of the occasional use of affusions in **typhoid fever,** from their power of arousing the circulation and the cerebral functions.

A **stream** of water, thrown with a certain degree of force from a pail against the **breast,** is an admirable excitant to **respiration** and **intellection**; hence, it may be used with notable effect to waken one from the stupor of **drunkenness. Other intoxications** than that of alcohol are benefited by affusions, which form an important adjuvant in the restoration of patients from alarming ether, chloroform, or opium narcosis. **Hydrocyanic acid** destroys life with such extreme rapidity that antidotal therapeutics are almost impossible. Cold water affords more hope of success than any other remedy. If the dose taken has been rather small, if the patient is seen immediately, cold affusions may succeed in averting a fatal termination. Any gain of time here is invaluable, since elimination, as well as absorption, is remarkably speedy, and if the patient can be tided over half an hour he will probably recover.

Cold water poured from a considerable height upon the head is one of the means upon which we may rely with some confidence in the management of **opium poisoning.** The respiration is strengthened, and a repetition of the procedure from time to time, as indicated by the con-

dition of the breathing, materially assists the action of other measures employed. Cold affusions may also be made use of with benefit in **sunstroke.** In **laryngismus stridulus** they secure speedy relaxation of the spasm.

The **douche** is a modified or limited affusion. A constant stream of cold water is sent against a selected portion of the body. The force of the current admits of regulation. A certain degree of friction is excited, the cutaneous circulation is directly influenced, the circulation and innervation of deeper parts is impressed by reflex action and by altered condition of the capillary circulation. The function of the absorbent vessels is stimulated. It is a measure which produces some shock and nervous excitement. Its use should **never** be long continued, but should be suspended and resumed; and care should be taken in administering it to persons of an excitable disposition.

The douche has an **important range** of adaptation, and is even **more effective** than affusions in **sunstroke, delirium tremens, chloroform** and **opium poisoning.** In delirium tremens it is often more effective in producing sleep than medication by drugs. In **fevers,** also, its use is frequently attended by very happy results in the relief of restlessness and the promotion of sleep. Cold water, applied by means of the douche or compresses, is one of the best methods of relieving the **headache** which frequently is so distressing and obstinate a symptom during the first week of **typhoid fever.** It is equally suitable to the headache which ushers in **other specific fevers.** Headache dependent upon **gastric derangement** may often be relieved in the same manner, as well as that form caused by exposure to the rays of the sun. Old **neuralgiæ** are not seldom relieved by the cold douche, which possesses the **advantage** that it can be readily applied to almost any portion of the body. The same application is of service in **chronic rheumatism.** It relieves the stiffness and the pain in the articulations and reduces the swelling, and will often cause absorption of old inflammatory deposits. The **shock,** both physical and psychical, of a plentiful cold affusion or douche, is remarkably effective in breaking up a **hysterical paroxysm. Pruritus** of the anus and vulva is often overcome by the cold douche.

The **bidet,** a modified douche, is an instrument used for the purpose of throwing a moderately forcible stream of water against diseased areas, chiefly used by surgeons in the treatment of rectal affections and derangements of the genito-urinary apparatus. A nozzle is connected by means of a rubber tube with the water-closet seat, so that the patient can adjust the force and regulate the temperature at will; but the stream should have sufficient power to cause slight tingling. No more is required, however, than is used for giving an enema or a vaginal injec-

tion, and the calibre of the stream should be slightly less than the size of an ordinary lead-pencil.

The **method of using** and the cases to which it is adapted may be briefly enumerated. As affecting the **rectum,** first in importance is hæmorrhoids, or piles; and along with that troublesome disorder should be included cases of prolapsus ani and recti, and pruritus. Two applications are recommended daily, the lower bowel having been first evacuated; and these affections are said to yield to this treatment after having long resisted the most approved methods of medication. The **genito-urinary** affections include varicocele, disorders of the prostate, and impotence in the male, and **pruritus vulvæ** in the female, the latter being by far the most formidable complaint, all things considered, which comes under the care of the physician; but it should be added that this plan, like many others, sometimes fails.

The **shower-bath** is a sort of **multiplied douche.** The water is broken up into drops, which pelt down upon the bather, who stands or sits in the tub beneath. The first shock is considerable, but reaction is prompt and vigorous. The shower-bath constitutes an excellent **hygienic** measure. Its therapeutical application, however, is rather restricted. It is, at least, scarcely available in cases of **acute disease,** but may well receive a place in a tonic course in chronic illness. By regulating the temperature of the water, the size of the drops, and the height of the reservoir, an individual may easily train himself to endure and derive the full benefit of the cold shower-bath.

The **cold sponge-bath** is a good method of applying water. The trickling of various little streams along different parts of the body produces a shock of moderate intensity, quickly followed by reaction. Its physiological effects are, therefore, those of a general cold-water bath, and its therapeutical indications and uses correspond substantially to those of the general bath. There are occasions upon which it may be more readily utilized. An ailing child will generally evince less aversion to a sponge-bath given in a small tub than to being plunged into a large quantity of water contained in a bath-tub. Considerations of this nature very properly govern our choice.

Cold sponging is an **excellent** remedy in **laryngismus stridulus.** The nervous system is braced, and that instability removed upon which the spasm depends. The same treatment proves effective in a more persistent spasmodic disorder, **chorea.** Performed **several times** a day, cold sponging diminishes the twitching by invigorating the source of nervous supply. The co-existence of subacute rheumatism is thought to furnish a **contra-indication** to this treatment. It is also an excellent procedure in **rachitis,** in addition to exhibition of the mineral salts of which the

organism stands in need. In this affection, and in chorea, also, if the general health be weak, the child should be accustomed gradually to the use of cold water, beginning with water of a moderate temperature and gradually using colder, upon the same principle that the graduated bath is employed in the management of typhoid fever.

By increasing **tissue waste** and **excretion,** and by stimulating **secretion,** baths promote the appetite and digestion. It is for this reason that **sponging** has demonstrated its utility in **anæmia,** and, consequently, in morbid conditions connected with impoverishment of the blood, as **leucorrhœa, amenorrhœa,** and **spermatorrhœa.** This condition it is, too, which frequently maintains a **gleety** discharge. Dr. Johnson, indeed, in his book on hydropathy, testifies to the ability of a course of cold-water treatment to cure **chronic gonorrhœa** and **urethral fistulæ.**

The **hip-bath** is a valuable appliance. The patient sits in a tub of suitable dimensions, immersed to the waist. The water may be of any temperature, according to the indications. The cold hip-bath is serviceable in **varicocele,** constringing the distended veins and lending tone to their muscular coats. It is likewise useful in some cases of **spermatorrhœa,** though, as a rule, this disorder receives more benefit from **warm** water. In **chronic metritis** cold hip-baths may prove useful. They should be taken immediately upon rising, and at first the patient should remain in the water but two or three minutes, leaving it as soon as reaction occurs. The **duration** of the bath may be gradually lengthened to ten or fifteen minutes. This treatment assists in the absorption of uterine and pelvic deposits.

THE USE OF ICE.—Though the treatment by ice is rather a mode of employing cold than moisture, yet, as being water under another physical form, and as we include under this section some consideration of vaporized and atomized water, we have thought proper to give, in the present connection, the **therapeutical applications** of **ice.** Indeed, the effects of ice differ from those of cold water more in degree than in kind. Its effect in **abstracting** febrile **heat** is even more marked than is that of the cold bath. It constringes the skin and contracts blood-vessels by its action upon muscular fibre. It blunts the **sensibility** of nervous tissue. It produces a powerful influence upon **reflex** nervous functions, and is, therefore, capable of exercising a great effect upon the circulation in deep-seated organs. No part must be subjected for too long a period to the effect of ice. So great a diminution in the blood supply and innervation of a part might be followed by gangrene, just as death of tissue results from **frost-bite.**

Ice is of great utility in the **reduction of temperature,** and on this account is quite a valuable resource in the treatment of **specific fevers.**

Especially should it be resorted to when the temperature is extremely elevated. Above all, it is of service in those diseases which affect the structure and function of the brain, either by reason of superheated blood or active congestion, or both combined. Notable relief is afforded in the **headache** of typhoid, typhus, cerebro-spinal, relapsing and yellow **fevers.** As both the circulation and the temperature are affected it proves of marked benefit in alleviating the agonizing pain of cerebral or **cerebro-spinal meningitis.** The suffering of **tubercular meningitis** is diminished, and it may also be of service in **infantile convulsions.** In the apoplectic form of **sunstroke** ice should be applied to the head and the body rubbed with ice in order to avoid the danger of fatal coma. The **delirium** of **fevers** often yields more readily to the **ice-bag** than to any other mode of treatment. In **delirium tremens,** likewise, the ice-bag will frequently afford relief. By causing contraction of the vessels, it is an admirable local application in **inflammation,** and will often prevent suppuration.

In inflammatory affections which involve the **throat** or **stomach,** ice is peculiarly appropriate, since it lessens the volume of blood, allays pain, cleanses the parts, assuages thirst, and checks vomiting. Hence, **pharyngitis, tonsillitis, diphtheria, membranous croup,** the **sore throat of scarlet fever,** are all benefited locally, to a limited extent, by directing the patient to suck small pieces of ice, but the method is open to the serious objection that unquenchable thirst follows, and this plan can be adopted with advantage only when ice is used at infrequent intervals. Occasionally, in the above-mentioned throat troubles, it is a good plan to surround the neck with cold compresses or an ice-bag. The intense burning pain and constant retching characteristic of **acute gastritis** are relieved temporarily to a striking extent by allowing lumps of ice to melt in the mouth. The effect of the cold upon the vessels and nerves of the gastric mucous membrane tends to limit the disease, but this method should not be continued too long, nor to the exclusion of other treatment. The nausea and thirst as well as the temperature of fevers are also lessened by ice when small lumps are swallowed and its use restricted.

Used externally, it is valuable in a number of **abdominal affections.** In the early stage of **typhlitis** and **perityphlitis,** it moderates inflammatory action. It will often relieve the pain and vomiting produced by **gastric ulcer,** and even **carcinoma.** It will sometimes enable a surgeon to replace a **hernia,** and it may be applied to a **prolapsed rectum or womb.** Light ice-bags are highly recommended in the treatment of **orchitis** or **epididymitis,** and **neuralgia of the testes** in the early stages. It reduces the size and the pain of **internal hæmorrhoids,** and may be used to mitigate the pain after operation for piles.

It is extensively employed in order to restrain bleeding. Slight

epistaxis is often checked by the sucking of ice. **Hæmorrhage** from the stomach or the lungs is diminished by applying ice externally to abdomen or chest. **Post-partum hæmorrhage** is often stopped by inserting pieces of ice into the womb or rectum.

By holding a block of ice in contact with the skin for a few minutes, sensibility is so much reduced that slight operations may be performed, such as incision of an **abscess,** removal of a **toe-nail,** opening a **sinus** or **fistula in ano,** or tapping an **ascites.** A **mixture of salt** with ice, one part of the former to two of the latter, will add to the anæsthetic power.

THE USE OF WATER IN DISEASES OF THE SKIN.—Warm water is far **superior** to cold in the removal from the integument of impurities or the products of disease. The warmth is grateful to the end-organs of the nerves. The cutaneous capillary circulation is **regulated,** and the **skin,** as a whole, is **softened.** These properties promote the health of the integument, and act as valuable agents, likewise, in the restoration of the health of the skin when it has been impaired. Scarcely an affection of the skin exists which may not be benefited by a suitable resort to **bathing.** In some cases warm or hot **fomentations** will supply the effect of general baths. Among the remedial measures adapted to **acne** are warm, hot, or vapor baths, while **sponging** with water as hot as it can be borne is one of the means which may be used to cause disappearance of the lesion of **acne indurata.** Hot-water baths are commendable in **anidrosis,** in order to restore the suspended function of the sweat-glands, and are useful likewise in the **other functional aberrations** of the perspiratory glandulæ, hyperidrosis, bromidrosis, and chromidrosis.

Alterations of the normal sensibility of the skin are relieved by baths. In **dermatalgia** and **paræsthesia,** hot water is frequently of the greatest service. The hot bath and the hot douche are alike beneficial. **Warm baths** promote recovery in **dermatitis, ecthyma, eczema,** and **hydroa**; in **icthyosis,** accumulated scales are removed. Baths, either plain or medicated, tend to **support nutrition** in patients afflicted with **lepra.** In **lupus vulgaris** bathing is a useful adjunct to other hygienic and therapeutic agencies. In **pediculosis** baths are an essential feature of treatment. Hot baths accomplish a good purpose in **psoriasis,** by softening and detaching the scales, leaving the underlying surface accessible to medicaments; and in **pityriasis, prurigo,** and **scabies** they are also found serviceable. Warm baths are extremely important in the treatment of **syphilis,** as much depends, in this affection, upon maintaining the functions of the cutaneous system.

Hebra has originated a **continuous water bath** which he uses and recommends in certain diseases involving the skin. A bath is so arranged that a person may lie immersed for weeks at a time. The fluid

may be moderately warm, or but lukewarm, and may be varied according to circumstances. Excellent results have been effected by this method. Evidently it is not one to meet with extensive employment in this country, yet the great destruction of tissue produced by severe **burns,** the attendant **shock,** the **exhaustion** due to extensive **suppuration,** the danger of **septic** or **pyæmic** infection, render continuous baths a valuable resource in the management of this severe traumatism. **Pain** is remarkably alleviated, the **surface** is kept cleansed, granulation promoted, and strength sustained by the continuous bath. The same procedure has proved of avail in **pemphigus. Septicæmia** and **pyæmia** have also been relieved by this method.

Both heat and cold have been advocated in the treatment of **frostbite**; the latter, perhaps, has been more generally employed. It has been feared that the sudden return of the circulation into the frozen part, favored by the application of heat, would be followed by destructive inflammatory action; but the experiments of **Laptchinkski** upon dogs seem conclusive, and lead to a reversal of judgment. "Of twenty animals treated by the method of gradual resuscitation in a cold room, fourteen perished; of twenty, placed at once in a warm apartment, eight died; while of twenty, immediately put into a hot bath, all recovered."

The influence of heat and of gentle, uniform contact with the surface subdues irritation or pain in **terminal nerve-fibres.** This influence, transmitted to the spinal cord and brain, relieves fatigue, diminishes restlessness, relaxes spasm, and produces a disposition to sleep. Warm or hot baths are, therefore, of marked benefit to those whose nervous system is perpetually strained by the anxieties of business life,—anxiety, suspense, and dread, or an alternation of hope and fear, **emotional states** constantly being produced by the claims of modern enterprise, especially when this assumes a speculative character. The physical states induced are loss of appetite and digestion, irregularity of the bowels, palpitation of the heart, headache, vertigo, insomnia, hypochondria, and a host of other **nervous ailments**, terminating, not infrequently, in some form of insanity. The condition is very often **complicated** by injudicious alcoholic stimulation. Warm baths afford considerable relief in such cases, soothing the irritated nervous system and procuring the grateful refreshment of sleep. Neuralgic pain is mitigated by warm baths.

Spasm is often extremely painful in itself, and often, again, it occasions great embarrassment or even **danger to life** by interfering with important functions. For instance, a degree of spasm is a frequent accompaniment of organic stricture of the urethra, and is kept up, it may be, by unsuccessful instrumentation. A full opiate and a warm bath have, upon numerous occasions, relaxed the spasm sufficiently to permit

the passage of urine. The suffering caused by **renal or biliary colic** is lessened by placing the patient in a hot bath. Extrusion of the calculus is also favored. Hot fomentation is attended by the same result. By relaxing the abdominal wall a warm bath may render possible the reduction of a **strangulated hernia.** Warm baths are beneficial in gonorrhœa, especially as it occurs in women.

The various symptoms incident to the **menopause** are alleviated; it is also useful in **uterine** and **ovarian** disease. In patients suffering from these affections the skin is cold and dry, or perhaps clammy. **Melancholia** is likewise often accompanied by a dry skin, and, whether the mental depression be related or not to the sexual apparatus, it is considerably benefited by warm baths. This observation is as old as Hippocrates. Warm baths have a wide range of usefulness in the **management of insanity.**

WARM BATHS IN FEVERS.—The warm as well as the cold bath is used in the treatment of **fevers,** specific or inflammatory. In a moderately warm bath the peripheral blood-vessels are dilated and full; the circulating fluid is temporarily withdrawn from internal organs and the inflammation reduced; the **blood,** long exposed to the surface, parts with a portion of its heat, and at the same time the **perspiration** is promoted and aids in the reduction of **temperature.** The same diseases, therefore, **measles, scarlatina,** and **small-pox,** in which cold applications have been recommended, receive benefit also from warm baths. Sir William Stokes has drawn a **graphic picture** of the comfort afforded by the warm bath in **small-pox.** Warm- or hot- water baths given once or twice daily in **croupous pneumonia** improve the patient's **subjective** sensations, reduce the **mortality,** and are especially valuable in aged patients.

Warm baths furnish a valuable means of aiding in the **elimination** of deleterious substances from the organism, and are resorted to in the treatment of **jaundice** and **chronic lead poisoning.**

Warm water, like cold, may be employed in a **variety of modes,**—the hot sponge-, foot-, or hip- bath, and, finally, in that modification known as the Turkish bath, the characteristic features of which have been described. Hot water is an admirable **hæmostatic,** and is largely used for this purpose in **surgery.** It has the property of coagulating the albumin of the blood and of causing contraction of divided vessels by stimulating the muscular coat. **Oozing** from small arteries or veins and from capillaries is very effectually **checked** by sponging with hot water. It serves at the same time to irrigate the wound, leaving the surface clean and thus diminishing the risk of infection.

A warm **sponge-bath** alleviates the **headache** which accompanies **acute catarrh.** The local application of hot water rapidly lessens the pain and

swelling of a **sprain.** A hot sponge-bath will diminish the excessive sweating in **phthisis.** The value of the hot foot-bath in **breaking up a cold** is a matter of common experience. It is of itself sufficient in many cases to restrain **epistaxis,** and is properly combined with other medicinal measures taken. A hot foot-bath will sometimes afford almost instantaneous relief during an attack of **urticaria.** Bathing with warm water promotes the granulation of **ulcers.**

The hot hip-bath is an excellent remedy in **cystitis, dysmenorrhœa, amenorrhœa, suppression of menses, chronic metritis,** and **endometritis,** and is beneficial also in **spermatorrhœa.** Hot water injected into the vagina is an excellent sedative in **chronic pelvic, uterine,** and **ovarian** ailments. Immersion of **wounded** and **contused parts** in **hot water** (95° to 100° F.) is advocated by Prof. F. H. Hamilton, of New York; he found that a sense of comfort was produced, that the wounds healed kindly, and that complications were of rare occurrence. The method is, in fact, essentially the same in principle as Hebra's **continuous bath.**

The **Turkish bath** is a more powerful therapeutical application than the simple warm or hot bath. It removes a great quantity of foreign impurities from the surface and **waste products** from the system. After taking the bath one feels buoyant in both body and mind. It has been found to be productive of a favorable influence upon **melancholia,** especially when the perspiration is suppressed. It is useful in those cases of **insanity** which arise from **toxic** causes, as lead or alcohol, or from general diathetic conditions, such as **rheumatism, gout,** or **syphilis.** It is an exceedingly valuable resource in **chronic rheumatism, gout, rheumatoid arthritis, lumbago,** and the severe **neuralgiæ** which often arise in connection with the rheumatic or gouty taint; as, for example, **sciatica.** It is capable of producing remarkable improvement in **eczema** and **psoriasis.**

It saves the strain upon the kidney in **Bright's disease,** and is especially valuable in the treatment of **uræmic accidents.** It soothes **muscular aches** and the pain of old wounds, aborts a **cold in the head,** and is a potent assistant in the treatment of **constitutional syphilis. Obesity** is diminished by a course of Turkish baths. They exercise a notable remedial effect upon diseases of the **respiratory tract. Quinsy,** chronic or subacute **bronchitis, winter cough,** the early stage of **phthisis,** and **bronchial asthma,** whether associated or not with chronic bronchitis and emphysema, are markedly improved by this measure. In all cases, however, we must take into consideration the vitality of the patient, many persons being unable to stand the depressing influences following a Turkish bath.

TOPICAL APPLICATIONS.—Water is thrown into the natural cavities of the body in order to accomplish various objects. **Rectal injections**

are used in **constipation**, and serve not only to soften the fæcal mass, but also to excite peristaltic action. They are serviceable in reducing extreme **flatulence** and alleviate the distress of **strangury, prostatitis, cystitis**, and **urethral diseases.** Medicated injections are used for the purpose of destroying **ascarides.**

Ice-water injections have been used in typhoid fever with the double purpose of reducing temperature and restraining diarrhœa. It is useful, likewise, in the collapse of diarrhœa and enterocolitis of young children. Dr. Robert M. Simon states that the injection of two or three ounces of ice-water into the rectum is frequently adopted in the Birmingham General Hospital with the best effects. Recovery from collapse is secured and refreshing sleep produced.

We have alluded to **vaginal injections** of hot water. Cold water is used as well, either plain or medicated. A stream of water may be run through the **nasal cavities** in order to remove morbid products and leave a clean surface for local medication, but this operation requires great caution. A stream of cold water run through a coil of rubber tube surrounding the penis is effectual in checking the hæmorrhage which sometimes occurs in the course of gonorrhœa. **Washing out the stomach** by means of a tube introduced into the viscus is a valuable procedure in chronic gastritis, dilatation of the stomach, and in cases of poisoning. Irrigation of the intestine has been practiced successfully by Dr. Simon Baruch, of New York, in the summer diarrhœa of infants.

INTERNAL USE OF WATER.—Water is a most valuable **beverage** in disease as well as in health. It promotes **moisture** of the **tongue,**—an important requisite to the sense of taste. It encourages the secretion of **saliva,** by which deglutition is facilitated and action upon amylaceous substances begun. It **removes** from the buccal cavity vitiated secretions and substances left about the roots of the teeth after mastication. These substances lead to the deposition of **tartar** upon the teeth, and form a suitable **nidus** for the development of various pathogenic microbes. **Rinsing** of the mouth, therefore, in conjunction with proper care of the teeth, is a hygienic and prophylactic measure of considerable value. Inflammatory processes at the upper portion of the **digestive** and **respiratory** tracts may often be avoided by **purification** of the mouth and pharynx. **Gargles** have been employed from time immemorial, and, if they accomplish no other purpose than removal of altered secretions and morbid products, constitute a form of local treatment not to be despised. **Ice** is of service in checking **buccal hæmorrhage** in purpura, scurvy, and after extraction of teeth, in the relief of epistaxis, and in symptomatic hæmorrhages occurring in the course of the specific fevers, as variola, scarlatina, typhus, etc.

Upon entering the **stomach** water is at first quickly **absorbed.** After a certain quantity has been received into the blood, the remainder is permitted to pass into the small intestine. The presence of a sufficient amount of fluid is necessary to the work of digestion, which is embarrassed if the water be deficient, while, if it be excessive, the changes of ordinary **fermentation** take place, instead of those of digestion. In the intervals of digestion water exercises a **detergent** effect upon the gastric mucous membrane. Iced water aids in checking the **hæmorrhage** and mitigates the **pain** of gastric ulcer. An abundance of lukewarm water produces **nausea,** and it is a good plan to assist the action of emetic remedies by administering copious draughts of warm water. Water as **hot** as can be swallowed is often an excellent remedy in **dyspepsia,** and is particularly adapted to an **atonic** condition of the gastric mucous membrane, although it cannot be used indiscriminately. The orifices of the muciparous ducts situated upon the tongue and in the mouth are brought into prominence and their contents passively **escape.** The same is true of the salivary ducts, and a large quantity of their saliva is constantly being discharged. We may fairly suppose that an analogous condition exists within the stomach. Hot water mechanically washes away the increased and altered secretions of the alimentary tract, stimulates the terminal nerve-filaments, and thus, by **reflex action,** secures improved circulation and secretion, with increased tonicity of the gland-ducts. Hot water, indeed, is an excellent **general stimulant.**

Upon the **small intestine** water exercises a salutary influence. Circulation and innervation are improved, secretion favored, and peristaltic action promoted. The functions of the **liver** and **pancreas** are stimulated. Bile and pancreatic fluid, of normal quantity and quality, are delivered into the duodenum, there to perform their appropriate parts in the work of digestion. **Inspissation** of the bile is avoided, together with its consequences, the formation of gall-stones, catarrh of the common bile-duct, occlusion, catarrhal jaundice, or biliary colic. The promotion of free secretion along the intestinal canal relieves **intestinal indigestion** and **constipation.**

A free supply of water has an important influence upon the condition of the **kidneys.** Owing to the feeble solubility of **uric acid,** even if not present in abnormal quantity, that substance tends to precipitation when the proportion of solids in the urine is increased, and irritation of the whole urinary apparatus results. Pyelitis, pyonephrosis, and stone in the bladder may often be traced to the **irritant** effects of uric acid. When the kidneys are **diseased** water stimulates their function and washes from their tubules the pathological products. Water as a beverage thus becomes a remedial agent in the various forms of **Bright's disease.** In

acute nephritis it assists the action of diaphoretic measures, and averts possibly the occurrence of **uræmia.** Much of the virtue of diuretic infusions or decoctions probably depends upon the large amount of water which they contain. Since a diluted is less irritant than a concentrated secretion the internal use of water is serviceable in **cystitis,** and even in **gonorrhœa** the scalding pain of micturition is somewhat lessened. In the latter affection the immersion of the penis in water as hot as can be borne often affords a notable diminution in the pain which attends the passage of urine. Vaginal discharges, both of specific and non-specific origin, are diluted and rendered less injurious to the surfaces over which they flow. The same diluent effects are produced upon the bronchial secretions in bronchitis.

Water should be given liberally to patients suffering with **fever.** It assuages the tormenting **thirst** and removes the products of **waste,** but should not, however, be taken in excessive amounts, as the sudden entrance of large quantities of water into the blood is attended with danger to the integrity of the **red corpuscles.**

It is always advantageous, when action upon the skin is desired, to **conjoin** the internal use of water with the other means employed to secure diaphoresis.

There are certain **contra-indications** which must be observed in the use of water; the hot bath is attended with **risk** in cases of weak heart and circulation. A fatty or dilated heart, atheroma of the great vessels, render the hot bath and, *à fortiori*, the Turkish bath **dangerous.** This should never be prescribed when there is reason to suspect the existence of senile changes in the cerebral vessels. There are cases of typhoid fever in which the surface feels cool, but the temperature, as ascertained by the thermometer, is high. When this condition is present cold baths should be avoided. The warm bath may then be substituted with good effects. When cold water is used, whether the tub or surf bath, an individual should leave the water during the activity following reaction, before the subsequent depression makes its appearance.

MASSO-THERAPEUTICS.

Massage is a system of treatment by which the body is subjected to a **series** of **manipulations.** The French designation, which we retain, is probably derived from the same source as Latin *massa*, a mass, and Greek *μασσω*, I knead.

HISTORY.—The germ of the practice may be detected in the rubbing and anointing associated, among the **cultivated peoples** of antiquity, with

bathing and calisthenic exercises. The **Greeks** laid great stress upon gymnastics as both a hygienic and curative measure. A passage in Herodotus leads to the inference that some proceeding of the kind was known to the **Egyptians.** Hippocrates states that the physician must be experienced in rubbing. Galen dwells at some length upon the advantages of properly performed friction. Ambrose Paré, Fabricius, and Sydenham extolled the benefits obtained by rubbing the body, and in the latter part of the last century Mr. John Grosvenor, a surgeon of Oxford, England, secured remarkable effects by the application of friction in selected cases. During the first half of this century the art was chiefly cultivated by the **French,** but it has lately been adopted in Germany, England, and the United States.

We learn from the reports of travelers that **uncivilized races** also have discovered that rubbing and kneading of the tissues restores the strength of fatigued muscles. The Tonga Islanders employ a species of massage, and have applied different names to the various acts of tapping, rubbing, and pinching. The Mulgarodocks, of New Holland, treat their patients by rubbing and flagellation with twigs. The natives of the Sandwich Islands have a custom which they term lomilomi, consisting of a combination of kneading and squeezing movements. It is described as producing a sense of refreshment and luxury, giving relief to headache, rheumatic or neuralgic pain, and as being a powerful aid to digestion.

All the practices to which allusion has been made bear some relation to the art of massage, inasmuch as all consist of **manual acts,** such as rubbing, pressing, tapping, kneading, and rolling. In massage as at present practiced these various acts have been combined into a **system.**

MODES OF PERFORMANCE.—As massage was, for a long while, chiefly employed by the French, many of the words used in designating its varieties are borrowed from the French language. No good reason exists, however, why they should not be replaced by their English equivalents. The name for the art itself, however, is too strongly entrenched to be disturbed. A good deal of confusion has been brought into the subject by the fact that different **classifications** of movements have been adopted by different practitioners and writers. All these, however, may be reduced to **four primitive movements:** friction, percussion, pressure, and movement. A **combination** of pressure and movement results in deep rubbing or kneading, and it is to this manipulation that the name massage is more strictly applicable. Each kind of action is attended by its peculiar effects, so that the best results are generally obtained from a combination or succession of movements.

The **manipulations** should be executed from the extremities toward

the trunk, and in lines parallel to the direction of the muscular fibres of the parts operated upon; that is, as a rule, from the **insertion** toward the **origin** of the muscles. In making friction, the **pressure** should be slight in the beginning, gradually increased, and diminished toward the end of the act. The fingers should be pushed in advance, and the pressure confined to the forward motion; in drawing the hand back it should merely graze the surface. Upon the limbs friction should generally be carried in the direction of the long axis. A useful **variation** is effected by using both hands simultaneously, moving one upward while the other is returning downward, in such a way that an oval is described around the axis of the limb. In advancing along the continuity of a surface it is expedient to take a new point of departure from the middle of the region already traversed.

The body should be divided into a number of **regions** of convenient size and boundaries. Thus, in operating upon the upper extremity it is advisable to take the hand from the finger-tips to the wrist as one region; the forearm as another; the arm, from elbow to shoulder, as a third. Upon the lower limb the foot constitutes one region; the leg, from ankle to knee being so much longer than the forearm, is conveniently divided into two districts, one embracing the antero-lateral, the other the postero-lateral, half. The same division of territory may be observed between the knee and the hip-joint. Upon the **back** of the body the movements should proceed from the occipital bone to the spine of the scapula in the direction downward and outward; from the spine of the scapula to the base of the sacrum and crest of the ilium forms another surface. Upon the **chest** friction should be directed from the insertion toward the origin of the pectoral muscles; upon the **abdomen** from the right iliac fossa along the course of the colon. The sides of the **neck** are stroked from the mastoid process downward to the clavicle.

Effleurage is the French word used to denote the rubbing or stroking movement. Deep rubbing or kneading is a still more valuable process, because it affects not only the skin, but exerts a powerful influence upon the **deeper structures.** It is also known as manipulation or **malaxation,** the latter name being derived from the Latin *malaxare*, to soften by kneading. This manœuvre is effected by grasping as broad a surface as can be taken up by the extended fingers, pressing and rolling the deeper tissues, and with them the integument. Care must be taken that the skin move along with the parts beneath. If this precaution be not observed chafing of the skin will result.

Kneading, like friction, is to be carried over successive areas, working from the extremities toward the trunk. **Individual muscles,** or successive

groups of muscles, should be, in turn, manipulated. Each **finger** of the patient is to be grasped between the thumb and the index finger and compressed. The tissues of the palm should be rolled, upon each side, away from the middle line. The muscles of the forearm and arm are treated *seriatim.* Upon the arm and lower limb each hand of an expert operator may be engaged upon separate areas. The pressure should be intermittent, in rapid successions of **compression** and **relaxation.** A slight stretching of the parts between the two hands of the operator is allowable, but if the hands approach each other too closely undue tension of the skin will occur. Muscles which lie parallel to the long bone from which they originate, such as the peronei and the anterior tibial group, should be grasped and rolled away from their points of origin. As in making friction, successive areas of the limbs and of the trunk should be manipulated by kneading. In executing the kneading movements **moderate** but not excessive force should be employed. If the force be too great the tissues are prevented from slipping or gliding upon each other, and injurious compression results.

The different **movements** which constitute massage are only to be learned by considerable practice. In this, as in every other manual art, dexterity is to be acquired by repeated efforts. It should always be under the direct **supervision** of the physician. It should be ordered and its **effects watched** with the same care as any of the ponderable therapeutic agents. The **duration** of a *séance* should vary according to the nature of the malady and the condition of the patient. In the beginning the procedures should not occupy more than fifteen minutes, and this time may be gradually extended to thirty or even forty-five minutes.

The **human hand** is, beyond question, the means by which massage is most beneficially performed, and it is doubted whether any mechanical substitutes which have been devised for it can prove of much avail. Attempts have been made to combine the advantages of electricity and massage by the use of electrodes capable of making graduated pressure, but no adaptation of pressure and movement can be as perfect as that by the trained hand. Nordhorst, of Wiesbaden, has lately described a **massage electrode** which has the form of a small roller. He reports very excellent results in rheumatic affections of joints, muscles, tendons, and nerves, and in migraine, and claims to have succeeded in relieving grave cases which had resisted the influence of massage and electricity used separately.

It is advisable that the work be done by the **attending** physician whenever possible, or at least by a physician who has acquired dexterity in performing the required movements. If neither of these courses be possible, the operator should be carefully superintended. It is a great

mistake to expect benefit from this mode of treatment if improperly carried out. The physician should be sufficiently acquainted with the subject to give clear and **precise directions** as to the movements indicated in each special case. No settled rule can be laid down respecting the **time** of the **day** when massage is best performed. Murrell* prefers a morning hour, but circumstances must govern our selection. If there be periodical **paroxysms** of **pain** we should endeavor to anticipate the attack. If the case be marked by **insomnia** an evening hour should be chosen. No **ointment** should, under ordinary circumstances, be applied. If the skin be unnaturally harsh and dry, or if damp with perspiration, a little ointment may be used. If the deeper tissues are grasped and moved with the skin, the latter cannot become abraded.

Percussion, tapping, or patting (tapotement) may be performed by the finger-tips, the palmar aspect of the fingers, by the palm or by the dorsum of the hand, by either the radial or the ulnar border of the hand, and, finally, by the half-closed hand containing a quantity of air. A modified percussion is directed immediately to accessible nerve-trunks, as, for instance, the median or the supraorbital. The **nerve** may be made to **vibrate** by friction transverse to its course or by **percussion** directly over it, and these taps may either follow the course of the nerve or be limited to a certain part of its trunk.

PHYSIOLOGICAL EFFECTS.—The benefit of **stroking** or **rubbing** (effleurage) is received especially by the skin, the functions of which are roused into full activity. The volume and the rapidity of the cutaneous circulation are increased. Both the perspiration and the sebaceous secretion are increased in quantity, and cutaneous respiration is more energetically performed. Hence, all the conditions of **improved nutrition** are fulfilled. An augmented **absorption** of oxygen is accompanied by a proportionate **excretion** of waste products. It is natural to suppose that the sensory and tactile end-organs participate in the improvement, and, furthermore, that a notable influence must be transmitted from the surface to the **central nervous system.** The acceleration of the peripheral circulation exalts the humble though not unimportant functions of the cellulo-adipose layer upon which rests the skin, and in which ramify the vessels and nerves which supply it. The exaltation of the circulation and nervous influence also promotes absorption. Pinching or tapping may serviceably alternate with stroking.

In order to affect the deeper structures **deep manipulation** is the more advantageous procedure. Intramuscular circulation is quickened. When the nutrition of the **muscular system** has been depressed by illness

* "Masso-Therapeutics, or Massage as a Mode of Treatment;" by Wm. Murrell, M.D., F.R.C.P. London: 1889.

we possess in massage a means of expeditiously restoring its vigor. The sense of **exhaustion** and the aches due to overexertion disappear under the practiced hands of a manipulator. Massage is, therefore, a **hygienic** or **restorative** as well as a **therapeutic** measure. It has been shown by Zabludowski that massage rapidly restores **muscular contractility** after it has been exhausted by induced electricity in frogs, or by physical exercise in man. A person able to raise a weight of one kilogramme (2.2 pounds) eight hundred and forty times by extreme flexion of the forearm was able, after massage had been performed for five minutes, to lift the same weight more than eleven hundred times without fatigue.

Muscular strength is increased by massage, which agrees with exercise in some of its effects, but not in all. As the invalid improves it is advantageous to combine some **active movements** with the passive exercises of massage. This is done by **resisting** movements. Thus, any of the movements of a limb may be made by the patient overcoming a certain amount of resistance on the part of the operator, or the latter may be resisted by the patient. Not only the **voluntary muscles** are improved by manipulation, but the same good effects are produced upon involuntary fibres. This fact is made use of in various pathological conditions, which we shall notice presently. The movement of the **blood** and the **lymph** in their conduits is largely influenced by **muscular contraction,** and upon the latter vessels this effect is produced both by the immediate pressure of contracted muscle upon lymph-vessels and by its action upon the lymph-spaces beginning in the fasciæ. Consequently, massage is capable, through its action on muscular fibre, of affecting the **circulation,** distribution, and composition of the blood. These results must be followed by an increased elaboration by the lymph-glands.

The favorable nutritive condition of **nerve-fibres** and **end-organs** induced at the surface by massage is reflected to the inner extremities of the nerve-cords, to ganglia and centres in the spinal cord and brain. A simultaneous or successive conduction of influence from many parts of the surface, affecting many centres, directly contributes to the **restoration** of **exhausted energy.** The blood is temporarily withdrawn from cord and brain. The **combined effect** of reflected influence and diminution in the quantity of blood received is to give repose to the nerve-centres, to quiet restlessness, to relieve pain and promote slumber. Massage of the **abdomen,** when properly performed, produces notable effects upon the viscera contained within its cavity. The muscular coat of stomach and intestines is excited to energetic peristalsis. The stimulant effect upon the **womb** and its **annexes** is perceived in the menstrual **function.** In man it invigorates the testes. Its influence upon the **abdominal muscles** and aponeuroses and upon the subperitoneal connective tissue must

prove a **safeguard** against development of hernia. The **urine** is increased in quantity and variously altered. There is increased production of the digestive fluids, and, therefore, an improved **appetite** and **digestion.** The action of the **heart** is lessened in force and frequency, and the **blood-pressure** diminished. This result is not due, however, to an **enfeeblement** of the heart-muscle, but to the fact that circulation is aided by the surface manipulations. Therefore, less demand falls upon the heart. The **respiration** is deepened and an increased amount of oxygen inspired.

Massage, like bleeding and purgation, **favors** the **absorption** and activity of medicines.

THERAPY.—From what has been said respecting the influence exerted upon the organism by massage, it will be anticipated that this agency is peculiarly well adapted for the relief of many diseased states, and will prove eminently useful in a host of **functional disorders,** while its stimulation of the absorbent system renders it efficient in the removal of **morbid deposits** ; it is, therefore, suitable to the treatment of many forms of **chronic inflammation.**

Since massage actively promotes the **nutrition** of the **skin** we have found it of benefit in many cases in which the nutritive processes had been perverted. When inactive, the **sebáceous glands** are stimulated, and, on the other hand, a **corrective influence** is exerted upon both the quantity and quality of their secretion. In the particularly stubborn form of **acne indurata** we have found it a very valuable means of promoting the resorption of inflammatory products, and the restoration of the glands and the hair-follicles to a normal condition. Benefit has also been derived from its employment in **seborrhœa,** in which disorder it manifests the same alterative effects ; the irritation subsides and the hyper-secretion is checked. Since baldness may follow in the train of **seborrhœa,** we have found massage to assist in the **preservation** of the **hair,** and it is, therefore, to be thought of in cases of **alopecia,** or alopecia circumscripta. Another disease connected with hair-follicles is **sycosis,** and in this also we have met with gratifying results from the employment of general massage. **Ecthyma** is always an evidence of faulty nutrition. We, therefore, seek to avail ourselves of every agent capable of improving the general condition of the patient. Among such agents massage takes a high rank.

In that protean affection, **eczema,** massage is useful, and is sometimes found efficient in subacute eczema, or in the very inception of **acute eczema.** Here, by local rubbing, the circulation is strengthened, blood stasis is prevented, and the slight exudation which may have occurred is removed by the absorbents. It is particularly, however, in the **chronic** form that we have been led to esteem masso-therapeutics.

The skin is often swollen and hardened almost to the consistence of leather by the inflammatory deposit. In this case well-directed manipulations will generally prove curative. Masso-therapy is the **best means** at our disposal for rendering old, infiltrated matter amenable to the action of the absorbent vessels. In **elephantiasis** deep manipulation of the affected part has led to excellent results; in the intervals compression should be employed. Very striking diminution in the size of cumbrous limbs has been observed to follow the use of massage, and the improvement was permanent. **Ecchymoses** of the face due to injury are, to say the least, unsightly; they may be more rapidly relieved by local massage than by any other measures. **Hæmatomata** of the auricle, a condition which generally gives rise to considerable deformity, may be dispersed in the same manner. This consequence is more effectually obviated by massage of the external ear than by any other plan of treatment. In the first stage of **furuncle,** before suppuration has taken place, gentle manipulation will not infrequently cause dilatescence. That painful and rebellious malady known as **herpes zoster,** dependent upon lesion of sensory nerve or ganglion, or both, may in many cases be rapidly relieved by massage performed over the course of the aching nerve. The functional disorders of the **perspiratory,** no less than those of the sebaceous glands, receive benefit from this mode of treatment. Hyperidrosis, anidrosis, bromidrosis, and chromidrosis will often disappear when the **general health** has been improved by the practice of massage. The same treatment is beneficial in **impetigo,** which, like ecthyma, is associated with lowered general health. Masso-therapeutics is of service in **lichen** planus and lichen scrofulosus, and is calculated to counteract the constitutional depression of lichen ruber.

The **neuroses** of the skin are markedly relieved by the employment of massage. It is true that these may be **symptomatic** of incurable organic disease of the brain or cord. They may, however, be **induced** by hysteria, syphilis, rheumatism, anæmia, chlorosis, or other affections which are susceptible of great improvement if not of actual cure. Even in **dermatalgia,** where a light touch is productive of suffering, or in the most annoying cases of **paræsthesia,** firm pressure is tolerated or has even a soothing effect. **General massage** allays irritation, abolishes tingling, itching, or pain, and is more effective in producing sleep than the most powerful **narcotic** drugs. Deficient **pigmentation** may be remedied by the same procedure. In **psoriasis** oxidation is promoted and decided gain results. Cutaneous lesions due to **scrofula** manifest rapid improvement, and it has also been demonstrated as of great utility in **syphilis,** especially when occurring in subjects of feeble constitution or additionally debilitated by any cause whatsoever, as intemperance, sexual

excess, insufficient food, clothing, or ventilation; in fact, it is especially appropriate to those instances in which a temporary suspension of mercurial and iodic remedies and the institution of a tonic course is indicated. Indolent or irritable **ulcers,** whether due to specific or ordinary causes, take on healthy reparative action during a course of massage.*

Diseases of the **muscular system** are so closely connected with those of the nerves by which they are animated, or of the nerve-centres from which their supply originates, that it is difficult to treat of the former without taking the latter into consideration. Muscles, however, cannot enjoy a proper degree of vitality without sufficient **exercise.** Disuse, partial or complete, is followed by loss of substance, flaccidity, and eventually by serious **degeneration.** We have no procedure at our command superior to massage in obviating the ill effects which accrue from this neglect of function. The enforced idleness dependent upon fracture, dislocation, joint disease, wound, laceration or inflammation of muscles, is followed by impairment of contractility; protracted general disorders lead to the same result. Under such circumstances, what can be better adapted to increasing the vigor of enfeebled fibres than massage, which affords them a species of exercise, increases circulation and cell-growth, favors the return of venous blood, and excites absorption of morbid or waste products? It is an admirable means of relieving the stiffness and pain of **lumbago, muscular rheumatism,** and the **rheumatoid pain** which follows fractures. It acts more promptly than any other measure in cases of **rupture** of **muscular fibres,** in which, however, bandaging should be conjoined. In **muscular spasm** it is an effectual remedy.

Masso-therapeutics seems peculiarly appropriate to disorders of the **nervous system,** from its power to allay headache and restlessness, produce sleep, and refresh the mental faculties. Gerst, of Wurzburg, has seen rapid relief follow stroking of the neck in **congestive headache.** This process assists the internal jugular vein in carrying off an excess of blood from within the cranium; pressure being relieved, the throbbing pain disappears. Excellent results are also obtained in the various forms of **neuralgia.** Massage may be performed upon the **head** and **face** in the treatment of neuralgia of branches of the fifth nerve or branches of the cervical plexus distributed upon the head and face. Stroking, or gentle friction, is the only manner in which massage can be applied to the head. The patient should be placed in a half-reclining position, the head a little inclined toward the operator, who may begin upon one side over the temporal region, proceed toward the occiput, and after this has been repeated several times the other side of the head may be manipu-

* "Massage in the Treatment of Skin Diseases," by John V. Shoemaker, A.M., M.D. Philadelphia Medical Times, June 15, 1888, p. 553.

lated. The forehead and the occiput may be stroked in a similar manner. Over the position of the **supraorbital** nerve percussion may alternate with stroking.

Traumatic **neuritis** has been cured by massage after the failure of every other measure. In that extremely painful and intractable disorder, **sciatica,** so often dependent upon neuritis, massage will succeed in affording relief after counter-irritation and electricity have been tried in vain. Other inveterate nervous maladies have yielded to the same treatment. Among these may be instanced **writers' cramp** and allied affections, as dancers', telegraphers', or violinists' cramp. The fulminant pains of **locomotor ataxia** are notably relieved and the progress of the disease often checked by means of massage. In **progressive muscular atrophy** the degenerative changes in muscles and nerves are held in abeyance for considerable periods. In **pseudo-hypertrophy** of the **muscles,** also, masso-therapeutics seems in some cases to have conferred benefit. Excellent results have been obtained from massage in **chorea.** It seems to be capable of restoring health more rapidly than the more usual forms of treatment. In certain forms of **paralysis,** as hysterical and post-diphtheritic, it has been found valuable either alone or in conjunction with electricity; it restores the tone of the depressed centres, and in peripheral paralyses due to injury the function of the affected nerve is restored. In lead paralysis it has also been found efficacious, while in infantile **paralysis** it has secured remarkable improvement. That curious condition called Dupuytren's contraction has been successfully treated by local massage. In those unfortunate instances of addiction to the opium or **morphine habit,** massage has been found to appease the morbid craving, and to replace, by its restorative effects, reliance upon the accustomed drug. The multifarious disturbances which attack the sufferer from **spinal neurasthenia** are relieved and the nutrition of the spinal centres improved by the systematic employment of massage. Dr. Murrell * suggests its use in **chloral** and **opium poisoning.** In **insanity** we may often have recourse to it with advantage, as in many cases of alienation, if we relieve the neurasthenia and improve the nutrition, we contribute directly to the restoration of healthy mental action. Remarkable improvement is effected in **hysteria** by the Weir Mitchell plan of **isolation,** rest, forced feeding, and massage.

The effect of massage exercised along the course of venous trunks supports and equalizes the circulation and prevents blood stasis, especially in the lower extremities. As a **hygienic measure** it counteracts a tendency to the formation of leg-ulcers and the dermatitis and eczema dependent upon this cause. Manipulation over the lymphatics assists

* Loc. cit.

the flow of lymph and the absorption of inflammatory deposits wherever situated. Norström has found that many cases of **neuralgia** or **migraine** are engendered, either through direct compression or reflex impressions, by hard nodules situated in the substance of muscles, or in the subcutaneous connective tissue. These nodules are the remains of preceding inflammatory attacks, and are found especially upon the back of the neck. Often, too, they exist upon the forehead and temples; they are very painful upon pressure, but will tolerate cautious manipulation which gradually dissipates them, together with the symptoms which they had originated. **Lymphatic glands,** enlarged by chronic inflammation, may be reduced in size in the same manner. By virtue of its influence upon the circulation, the respiration and the skin, furthering the absorption of oxygen and the elimination of carbonic acid and other products of retrograde metamorphosis, increasing the appetite and invigorating digestion, massage proves of utility in the treatment of **anæmia.** Professor Maclean, of Netley, England, has found it of service in **intermittent fever,** in which it lessens internal congestion, and increases the functional activity of the bowels and skin.

Certain affections of the **womb** are greatly ameliorated by the practice of massage. It is very efficient in producing the catamenial flow. Dr. Graham, of Boston, in his excellent treatise * states that he has come to regard its **emmenagogue** power as "one of the physiological effects of massage." It is, accordingly, indicated in **amenorrhœa.** It diminishes the suffering attendant upon **dysmenorrhœa,** and is sometimes effective in cases of **sterility.** A modified form of massage has lately been introduced with a view to strengthening relaxation of the pelvic tissues and organs, as well as the floor of the pelvis, correcting **prolapse** and **malpositions** of the uterus, and securing the absorption of exudations or cicatricial adhesion bands.

A method designed to accomplish these purposes was originated in 1874, by Thure Brandt, of Stockholm An adaptation of masso-therapeutics to the uterus and surrounding tissues was described in 1880, by Prof. A. Reeves Jackson, of Chicago, to the American Medical Association, without any knowledge of the plan of his Swedish predecessor. Brandt's method consists essentially of four series of manipulations: 1st, raising the womb; 2d, massage of the womb and its ligaments; 3d, forced abduction and adduction of the knees; 4th, percussion of the lumbar and sacral vertebræ. Very **encouraging reports** are made as to the efficacy of this treatment in prolapsus uteri, subinvolution, exudations or cicatricial bands due to chronic para- or perimetritis, chronic endometritis, and uterine displacements.

* "A Practical Treatise on Massage," by Douglass Graham, M.D. New York: William Wood & Co., 1884.

Masso-therapeutics succeeds admirably in **constipation.** Dr. Douglass Graham recommends that manipulations should be begun in the left iliac fossa, working thence upward over the course of the descending colon, then along the transverse and ascending until finally the origin of the large intestine is reached. Besides the mere mechanical effect of unloading the large gut, the muscular coat is excited to contraction. Applied over the small intestine, massage probably stimulates not only that portion of the intestine, but also the large ducts which open into it. Volvulus, or invagination of coils of small intestine, can often be released by manipulation of the abdomen. When this fact is borne in mind it is rash, to say the least, to open the abdomen until massage has been given a trial.

Chronic **hyperæmia** of the **liver** and the attendant indigestion and reflex disturbances are effectually relieved by massage practiced first over the abdomen generally, and then localized over the hepatic region. In this situation tapping may alternate with stroking, and the lower border of the organ may itself be manipulated. The best time for this operation is midway between meals, when the stomach and upper bowel are comparatively empty. The head and shoulders of the patient should be elevated, and the thighs flexed so as to afford the utmost relaxation to the abdominal muscles. In this connection we may allude to Dr. George Harley's treatment of **gall-stones.** He finds that he is able to extrude these, as well as biliary sand and gravel, from the gall-bladder or duct by means of digital pressure made directly over the distended fundus. This involutes the gall-bladder, and the obstruction is dislodged and forced into the duodenum. Massage occasions marked improvement of the functions of the **stomach.** Its influence upon the circulation and innervation of the organ favors the secretion of gastric juice, sharpens the appetite, and facilitates digestion. It induces contraction of the muscular coat and administers also to its increased nutrition. These effects render it an admirable remedy in cases of **dilatation** of the stomach, enabling the organ to expel its contents after they have been sufficiently acted upon and obviating the consequences of **fermentation.**

Masso-therapeutics would seem to be rationally indicated in many cases of organic **heart disease**, since it lessens the work laid upon the central organ of circulation. When compensatory hypertrophy is failing, when the heart is weak, either by reason of dilatation, fatty infiltration, or an accumulation of fat pressing upon it, this mode of treatment should be marked by beneficial results. It has, as we have already shown, the power of absorbing transudations as well as exudations, and this power may be called upon for the relief of **œdema,** whether due to cardiac or kidney disease. In the weak heart and lax muscles, present in convalescence from protracted and serious illness, the passive exercise of

massage will be found decidedly restorative. When the processes which take part in the complicated metamorphoses connected with nutrition are bettered as a result of manipulative treatment, those persons who had been slender generally gain in flesh. Conversely, those who are burdened by an overgrowth of adipose tissue may, as Dr. Benjamin Lee, of this city, has shown, be reduced in weight by the same treatment. Its roborant and antispasmodic virtues would probably cause it to be of service in **spasmodic asthma,** while by aiding the heart and circulation it contributes to the relief of **vesicular emphysema.** Its influence upon the digestion, circulation, and respiration renders it a reliable mode of treatment in the earlier stages of **phthisis.**

Disease of the **joints** constitutes one of the most favorable fields for the display of the efficiency of massage. **Hydrarthus** is very susceptible to improvement from this measure. If but moderate in degree and not of too long duration, massage, supplemented by compression, will effect a permanent cure. If the sac be enormously distended aspiration should first be performed. It assuages pain and prevents stiffness in **periarthritis,** and surpasses any other mode of treatment for **sprains.** Dr. Douglass Graham has analyzed the results in three hundred and eight cases of sprains and **joint contusions,** and ascertained that the average length of time before recovery took place was 9.1 days for those treated by massage, whereas the average time under other methods was 26.16 days. The **best results** are obtained when massage is applied very soon after the injury has been received. As soon as it can be borne, passive motion should be conjoined. In chronic **synovitis** the same excellent results have followed. Stiff, swollen, and painful joints, due to **chronic rheumatism,** are rapidly relieved by the same process, while wonderful improvement has been obtained in **rheumatic gout.** Joints which had been extremely distorted and painful for months and years have resumed their functions to a very considerable extent, and patients who had long been bedridden have been able to walk after a course of local and general massage. In old cases, **passive motion** and the use of splints should be conjoined. False **anchylosis,** left after fractures or dislocations, is benefited by massage. It promotes the union of **fractured bones** and removes exuberant callus.

Morbid growths of a benign character will sometimes recede during a course of massage, and it is probable that this result would be more common were the treatment oftener directed to that end. Many patients would gladly escape the knife at the sacrifice of their time. By his method of massage of the neck, Gerst has succeeded in rapidly relieving **catarrh** of the nose, pharynx, larynx, and frontal sinuses.

Massage of the head, forehead, and eyelids is attended with benefit

in many cases of **affections** of the **eye.** Donders, Just, and Pagenstecher have applied it to the **eyeball** by means of stroking the lids. It has proved useful in abscess and opacities of the cornea, chronic pustular conjunctivitis, scleritis and episcleritis, glaucoma, blepharospasm, astigmatism, and hyperæmia of the retina. It diminishes intraocular tension, lessens hyperæmia, and promotes absorption.

Synergists.—The power which massage possesses of improving the nutrition of the muscular and nervous systems and of stimulating the circulatory apparatus is shared by other therapeutic resources or remedies. **Electricity,** for instance, has been found useful in many of the cases to which massage has been applied with advantage, while the same remark holds good concerning certain tonic **drugs** which are used to promote constructive processes, such as iron, quinine, the mineral acids, cinchona, nux vomica, and hoang-nan; and no plan of treatment can eventually be successful unless reinforced by a **liberal, nutritious dietary.** All these measures may, therefore, be regarded as of mutual assistance, and may often be administered in combination.

In the treatment of many of those disorders of the **nervo-muscular system** in which massage is advantageous, as well as in many **visceral** troubles, **electricity** may be, and often is, conjoined; and in disturbances of digestion an appropriate dietary with **tonics** or **digestive ferments** may very rationally be prescribed.

Baths, also, are often serviceably used in conjunction. These measures may all be regarded as **synergists.** Nevertheless, the range of adaptation is never precisely the same among the members of a group of synergists. The exact **indications** and **contra-indications** of each need separate study. Not infrequently masso-therapeutics will prove successful in a case where electricity has failed. Again, massage will disappoint our expectations, because used for the relief of a malady to which it is not suited.

Every potent remedy must have its **drawbacks**; such agents are as powerful for ill as for good. Massage is no exception to this statement. If used indiscriminately, or if the sittings be too long, it is capable of **aggravating** the symptoms which it was intended to relieve, and it may even produce alarming **syncope.** Careful attention, therefore, should be given to its **contra-indications** as well as to its indications. **Accuracy** in **diagnosis** is a necessary prerequisite to the solution of the question whether masso-therapeutics is applicable or not to a given case. Massage, it has been maintained, is not a proper mode of treatment in **organic disease,** but large exceptions must be made to this statement. The principal **contra-indication** is the presence of **acute inflammation** wherever situated. In some instances subacute inflammation or the hyperæmia preceding

an acute attack may be relieved and the disease cut short in its incipiency, but massage during the height of the process is painful and likely to **hasten suppuration.** Danger would arise, also, from inflammatory products being forced into the circulation. A sufficient interval having elapsed after the subsidence of an attack of acute inflammation, massage is, as we have pointed out, valuable in **promoting** the **absorption** of the products and in preventing a serious impairment of function.

The existence of an **aneurism** or an **ulcer** of the **stomach** is generally held to be an objection to the employment of massage. It appears reasonable in the former case to fear rupture of the sac, or the effects of **emboli,** although Sir William Fergusson manipulated two cases of aneurism of the subclavian artery with entire success. It is, however, a doubtful and dangerous therapeutic measure. Massage is **injudicious** in atheroma of the cerebral arteries, in softening or tumor of the **brain,** and in many cases of **paralysis** it is valueless or even apt to lead to evil consequences. After an attack of **hemiplegia** it should not be hastily employed, but when the patient has recovered from the immediate results of the attack and there is reason to believe that the clot has become absorbed, it may be good practice to begin the cautious use of massage in order to improve the nutrition of the disabled muscles. In **chronic myelitis** the procedure is unlikely to be of any avail, and it seems to afford no benefit, or even to aggravate the symptoms of **lateral sclerosis** of the cord. In **neuritis,** while the nerve-trunk is tender, massage is likely to increase the pain, and even in **neuralgia** its effects are more apparent in **old** than in **recent** cases.

In **cerebral neurasthenia** it has not been attended with encouraging results. In these cases, the consequence of long-continued mental strain, more benefit is derived from complete change of scene and muscular exercise in moderation. Massage is **prejudicial** in iritis or in any affections of the eye attended by photophobia and lachrymation. It should be used, if at all, with great circumspection in cases of **malignant new formations,** especially when these occur in **internal organs,** as it may determine increased growth of the tumor or hæmorrhage. But even in **carcinoma,** as in other incurable organic diseases, the **anodyne** virtues of massage may be manifested. Dr. Murrell records a case in which it afforded great temporary relief to a lady, the subject of recurrent carcinoma of the axillary glands after removal of the breast. When, however, we remember the sudden furious growth of a cancer or sarcoma from so slight a cause as the insertion of an exploring needle, we may well believe that massage is **inadvisable** in **malignant neoplasms** of all descriptions.

In conclusion it may be added that a male who performs massage is styled a *masseur*, a female is a *masseuse*, while the verb meaning to perform massage is *masser*.

HEAT AND COLD.

SOURCE OF BODILY HEAT.

Heat is a **mode of motion** which takes place, under certain circumstances, among the atoms of which matter is composed. It is one of the forces of nature, and is capable of being generated by or transformed into the other physical forces; or, as the idea may be otherwise expressed, the different modes of motion among the **ultimate particles** of matter are, under appropriate conditions, mutually **convertible.** We recognize heat by the effects which it produces in matter external to us, and also by our own **sensations.** The **physics** and the **physiology** of heat must, therefore, be very nearly related.

Heat is **derived** from mechanical sources, such as friction, compression, and percussion; from physical sources, such as the sun and stars, radiation from the earth, and from atmospheric electricity; thirdly, from chemical combinations, especially combustion. However produced, it gives rise, at the same temperature, to the same effects. The **fourth source** is that with which we are particularly concerned, namely, the changes which take place within the bodies of living organisms. Since these changes are always accompanied by re-arrangement of chemical relations, the **physiological origin** of heat is essentially **chemical.** The development of animal heat, consequently, is due to what is inherently the same process, **oxidation,** as that by which fire and heat are produced externally, that is, **combustion.** Chemical changes of the same nature are occasioned when heat is engendered, whether within or without the human body. All organized beings evolve, in the processes of life, a certain amount of heat; it is no less true that life cannot be sustained unless the surrounding medium be of favorable temperature. A close relation exists between heat production and heat absorption.

To limit, now, our attention to the **human organism,** it may be stated that in whatsoever organ or tissue oxygen becomes united to other chemical elements heat is produced. This, however, is equivalent to saying that, as no animal tissue can exist without the consumption of oxygen, the production of animal heat must be due to the processes by which life is manifested in every tissue and organ entering into the composition of the human body. Such, undoubtedly, is the case. Nevertheless, since all parts of the organism are not equally active, it is to those whose functions are most important and most frequently called into exercise that we must look as the **principal generators** of animal heat.

The most distinctive characteristic of animal organisms is their

power of voluntary motion. As the muscular system constitutes so large a proportion of the body-weight, and is so continually engaged in functional activity, we are prepared to anticipate what has been demonstrated experimentally, that **muscular contraction** is the principal source of the heat of the human body. Muscular exercise invites an increased supply of blood, and, therefore, of oxygen to the tissue. More rapid chemical changes result, and these are attended by the evolution of heat. Billroth and Fick observed an increase of more than 5° C. in warm-blooded animals in which a tetanic condition was maintained for ten minutes. The **degree of heat** produced depends upon the tension and freshness of the muscle and the amount of work performed. Solger, Meyerstein, and Thiry have stated that at the beginning of a contraction there is a slight fall in the temperature of a muscle, and that this depression continues for several seconds, being succeeded by a gradual rise, which persists, in a tetanized muscle, for some time after contraction has ceased. M. Mendelshon* has recently directed his attention to this subject. He asserts that heat is developed as soon as contraction begins continues to be produced while the muscle is exercised, and ceases during the period of relaxation.

Much heat is also set free by the **chemical changes** which take place in secreting glands during their periods of functional activity. In accordance with this fact it is found that the blood of the **portal vein** is sensibly warmer than that which circulates in the arterial system. This is especially the case during digestion. The blood of the **hepatic vein** may be 2° or 3° F. warmer than that of venous blood in general, while in the right cavities of the heart it is of higher temperature than in the left, parting with a portion of its heat in its passage through the lungs. The process of **digestion**, accompanied by so many and such complicated acts of decomposition and re-combination, contributes a notable share to the bodily warmth. The union of acids with bases and the conversion of neutral into basic salts are constantly attended by the development of heat. The combination of respired oxygen with the hæmoglobin of the blood is another element in the increase of temperature. An increment is likewise added by the functional activity of the **brain**. Furthermore, the mechanical energy of the **heart** in overcoming the obstructions to the circulation is to be reckoned as a source of heat.

It is generally **supposed** by physiologists, though not regarded as a demonstrated fact, that a **heat-centre** exists in the brain, the office of which is to control, by an inhibitory influence, the chemical activities which are the immediate source of animal heat.

According to the rate of physiological heat-production it has been

* Société de Biologie, July 6, 1889.

calculated that the temperature of an adult man is raised 1° C. in half an hour, and that, therefore, in thirty-six hours the boiling-point would be attained. It is plainly obvious from this consideration that nature must have provided means by which an **accumulation** of heat within the body is **avoided.** The **provisions** by which the reduction of temperature is effected we find upon examination are identical in principle with those by which heat is distributed in the external world, namely, the performance of work, radiation, and conduction. A portion of the heat generated within the organism is employed in warming the secretions and excretions, particularly the urine and the fæces. It has been estimated that from 3 to 6 per cent. is used in the execution of this work. A second modicum, varying from 9 to 20 per cent., is lost in heating the air which enters the lungs and in vaporizing the water eliminated by the pulmonary surfaces. The **integument,** however, is the **chief medium** by which the balance is maintained. Heat is removed from the surface by radiation, conduction, and by promoting the evaporation of the perspiration. By these processes from seventy-seven to eighty-five per cent. of the heat generated internally is abstracted. Heat is lost to the human body by radiation and conduction precisely as it is to any inanimate object. A large proportion is consumed in evaporating the sweat which, when secreted, is at the temperature of the body.

By these beautiful regulations the **continuous production** of heat is **counterbalanced** by its continuous dispersion. So exact is the **equilibrium** that the temperature of man, in a state of health, differs but slightly in the torrid or the arctic zone. According to Wunderlich it ranges between 97.25° F. and 99.5° F., the mean being 98.6° F. Any marked **variation** from this point, either above or below, is indicative of **disease.** The **pathological conditions** which influence temperature are, however, much more efficient in producing an elevation than a depression.

PHYSIOLOGICAL EFFECTS OF HEAT.

Different degrees of **atmospheric heat** are recognized by the terminal nerve-fibres distributed to the epidermis. The function of the **tactile corpuscles** is solely to minister to the sense of touch or pressure. As these separate purposes are subserved by different peripheral arrangements, so, it is surmised, are the conducting fibres for each kind of impression connected with different **cerebral centres.** The first effect of moderate heat is upon the peripheral filaments of the nerves. The **impression transmitted** to the brain is perceived as heat. The **consequent results** are due to reflex nervous influence, originating in those centres which preside over the action of the heart and lungs, and the calibre of the blood-vessels.

Atmospheric air, like gases in general, is a poor conductor of heat. It, however, always contains a variable proportion of moisture, and, as liquids are better conductors than gases, the more humid the air the better conductor it becomes. As exposure to heat soon produces perspiration, the quantity of **watery vapor** in the air exercises an important influence upon evaporation, and, consequently, upon our sensations and endurance of a considerably elevated or depressed temperature. Since an atmosphere which contains a large quantity of moisture checks evaporation, **dry heat** is better borne than moist heat. Since, also, a damp atmosphere is a better conductor than a dry one, **dry cold** is better sustained than moist cold. These facts bear an important relation to the effects of **climatic changes** upon the health. They likewise explain why water feels either colder or hotter, as the case may be, than air at the same temperature.

The hands may be plunged into water at 50.5° C. (122.9° F.), but not at 51.65° C. (124.9 F.), while at 60° C. (140° F.) violent pain is produced. One may remain immersed in a **bath** at 45.5° C. (113.9° F.) for about eight minutes, although the experiment is **dangerous** to life. **Hot air,** however, may be endured for an equal length of time at 127° C. (260.6° F.), while 132° C. (269° F.) has been borne for ten minutes.* The workmen of Sir Francis Chantrey were accustomed to enter a **furnace** in which the thermometer registered 350° F., while Chabert, the "Fire King," was able to support for a short time the heat of an **oven** at 400° to 600° F. These examples are of use only in serving to illustrate the variable susceptibility of the system to moist or to dry heat.

The effect of the exposure of the body to a **moderate degree** of heat for a short time is to cause dilatation of the cutaneous blood-vessels. The enlarged area is soon filled by an increased afflux of blood, the integument is softened, and copious perspiration is excited. Reflex excitation leads to increased rapidity of the heart's action, with consequent acceleration of the pulse. The number of respirations and the quantity of watery vapor exhaled by the lungs are simultaneously increased. These conditions combine to favor a **rapid elimination** of heat, so that a slight actual decrease of temperature is produced. The influence of external heat is thus overcome by a greater rapidity of the processes by which the organism parts with its heat.

If, however, the external temperature be further raised the body absorbs heat from its surroundings. The internal parts become heated by conduction, the economy is no longer able to relieve itself, and the structure as well as the function of organs is affected. MM. Berger and Delaroche found that exposure for seventeen minutes to air of 120° F. was

* Landois and Stirling's Physiology.

attended by a rise of nearly 7° in the bodily heat, as registered by a thermometer placed in the mouth. Drs. Fordyce and Blagden inclosed a dog for half an hour in a chamber, the temperature of which ranged between 220° and 236° F. As a result, the animal's temperature rose from 101° to 108° F. From numerous **experiments** it has been ascertained that death results when animals are subjected to a temperature of 11° to 13° above the normal of health. **Fatal consequences** follow sudden exposure of warm-blooded animals to 109° to 111° F.

A **high degree** of heat causes, in the human being, rapid, tumultuous, and irregular action of the heart, which may beat one hundred and sixty times or more to the minute. The respiration is correspondingly quickened, the blood-vessels of the skin are distended and the secretions checked. Chemical changes proceed with increased activity, the **blood** becomes dark and contains little oxygen, the albuminous constituents of the organism undergo fatty degeneration, and when the temperature of the body, as a whole, is raised 6° C. above normal, molecular decomposition occurs.

CAUSE AND EFFECTS OF FEVER.

When the **equilibrium** which exists between the production and discharge of heat is **disturbed** the temperature of the body is either elevated or depressed according as production exceeds or falls below dissipation. The **causes** and conditions which secure the former are much more numerous than those which give rise to the latter result. The **effects** are, also, usually, more conspicuous from the elevation than the depression of temperature. Diseases in which the changes of tissue proceed languidly are generally accompanied by but a slight fall.

Fever is produced by the co-operation of a number of causes which increase the **production** of heat without any proportionate increase in its **abstraction.** Indeed, the processes by which heat is eliminated are usually impaired so that increased generation co-exists with decreased loss. It forms no part of our intention to dwell upon the cause of fever; its origin is, in fact, obscure. We entertain a well-grounded belief that each different variety of specific fever depends upon the growth, multiplication, and life processes of a specific **pathogenic microbe,** introduced from without into the organism, or modified by the disease present. The details of the mode in which infection is accomplished have not yet been thoroughly elucidated. It is generally considered, however, that the result may be produced by the blood or solid tissues being despoiled of oxygen or other important constituents by the **growth and decay** of the disease-germs, with consequent alteration of chemical composition, or by the discharge into the circulation of excrementitious products, which act

as direct poisons (ptomaines, leucomaines and extractives). The **nervous system** is quick to feel the consequences of an altered state of the nutrient fluid. The **heat-centre** is paralyzed, its inhibitory influence lost, and chemical affinities are left free to satisfy themselves without hindrance.

It is, however, with the alterations effected in the economy that we are here concerned, rather than with explanations of the precise mode in which those changes are originated. Whatever the genesis of different varieties of the febrile condition, we find an identity in many of the **effects produced** upon the components of the body. We learn, moreover, that in the main these effects agree very closely with those produced by mere elevation of temperature, irrespective of its cause. Whether an abnormal degree of warmth be engendered by processes excited **within** the organism, or whether the heat be artificially supplied from **without,** its consequences must be substantially the **same** upon the structures subjected to its influence. Yet the description of damaged structure and altered function, due to increased temperature, does not form the **complete picture** of a specific fever. Superadded to the effects of heat are those occasioned by **toxic materials** derived from the activities of the pathogenetic micro-organism. A definite specific fever—typhoid, for example—in its entirety, is the expression of the **combined influence** upon the human organism of toxæmia and elevation of temperature.

Certain **pathological alterations** are common to fever as such, and betray no immediate dependence upon the specific cause which inaugurated the disease. A temperature of 107° F. is productive of the same or similar effects upon the tissues of the heart or voluntary muscles, liver, spleen, or kidneys, whether it be due to typhoid fever, acute rheumatism, or attendant upon an inflammatory process. The lesions of Peyer's patches in **typhoid fever,** the joint and valvular affections in **rheumatism** are referable to the **specific causes** of those disorders. The **primary** and the **secondary effects** of the development of micro-organisms—toxæmia and high temperature—are so inextricably blended that the estimate of the relative consequences of each is perhaps impossible, and we allude briefly to them in this connection on account of the therapeutical indications which they suggest.

Fever early exerts a special deleterious influence upon the **nervous system.** It is probable that a morbid impress upon the **heat-centre** or the **vasomotor centre** is an important factor in the inauguration of the process. However that may be. one of the first definite manifestations of the disease is a subjective feeling of cold, attended by shivering or rigors, which even, in young children, rise to the height of **convulsive** seizures.

The severity of the initial chill furnishes an approximate indication

of the intensity of the ensuing disease. That the **metabolism of tissue** which accompanies fever has already begun is demonstrated by the thermometer inserted into the rectum. The spasm which marks the chill is shared by the cutaneous blood-vessels, communicating to the skin, at this stage, a pale and bloodless appearance. The **skin,** as well as its vessels, is contracted, and the blood is driven into the deeper viscera. **Relaxation** of the spasm is followed by a rush of blood to the surface. The action of the **heart** is quickened and the **respiration** becomes more rapid. The **secretions** are diminished in quantity and altered in quality. The **tongue** loses its moisture and becomes covered, as the case progresses, with thickened, morbid secretions and accumulated epithelium. The mucous membrane of the **stomach** becomes dry, and the gastric juice is diminished and vitiated. **Appetite** is abolished, **digestion** impaired, and vomiting frequent. The **bowels** are generally constipated, except in typhoid fever, in which diarrhœa is excited by the intestinal inflammation, the products of which it serves to remove, but this is not always the case. The skin grows dry and harsh, the air-passages become irritated. Headache, stupor, delirium, and perhaps convulsions, disorders of mobility, sensibility and special sense are symptoms of perturbation of the nervous centres. **Muscular debility** becomes extreme, and adipose tissue is consumed. The **nitrogenous components** undergo waste and degenerative alteration, the **kidneys** are able to perform their functions but imperfectly, and the **blood** becomes surcharged with waste material, the result of increased tissue destruction and diminished elimination. The **blood-corpuscles** are subjected to disintegration ; the **liver** and **spleen** suffer from congestion and softening. The **depravation** of the **blood** adds an important element of **danger** to the situation, and in severe cases it appears problematical whether life shall be terminated by poison of the nerve-centres, or by failure of the heart's contractility. The voluntary **muscles** and the heart-fibres become the seat of **fatty transformation,** while the cells of the liver and kidneys are similarly affected.

The quickening of the **circulation** and **respiration** and increased inhalation of oxygen serve to add increased pabulum to the work of destruction on account of suppression of the eliminative and refrigerant function of the skin. The energetic **chemical changes** which go on during fever give rise to increased excretion of compounds which represent consumption of tissue, notwithstanding the impaired emunctory powers. The amount of **carbonic acid exhaled** is augmented 70 or 80 per cent. above the standard of health. The quantity of **urea** discharged is increased by from one-half to two-thirds. According to Senator, in the early stage a fever patient excretes three times the quantity of urea that he would in health if he subsisted upon the same diet. Much more **uric**

acid, also, is found in the urine. Twenty times as much **urinary pigment** is present as under normal conditions. The **potassium** excreted is increased sevenfold.

It has been estimated that in the **cold stage** the generation of heat is doubled. During the **hot stage** the large quantity lost by radiation from the hot skin is insufficient to compensate for the increased production. In the **sweating stage** the dissipation of heat is two or three times greater than in health.* It is to be observed that each increment of 1° F. is accompanied by a proportionate acceleration of the circulation and respiration. The **phenomena** of fever are **heightened,** as might be anticipated, by warmth of the atmosphere. Cold surroundings also serve to intensify the process, but not to the same degree.

Recovery is scarcely possible if the thermometer registers 42.5° C. (108.5° F.) for any length of time, while the blood is said to coagulate within the arteries at 42.6° C. (108.68° F.). The **highest temperature** ever encountered by Wunderlich was 44.65° C. (112.37° F.). This occurred just before **death,** but cases in surgical practice have been recorded in which the temperature has mounted even higher.

It is a **curious fact** that the temperature should sometimes continue to rise after death from fever. Dr. Bennet Dowler, of New Orleans, found, in a case of **yellow fever** in which the highest temperature observed during life had been 104° F., that after the lapse of ten minutes the thermometer in the axilla registered 109° F., and fifteen minutes after death the mercury had attained 113° F. when placed in an incision made into the thigh. Dr. Carpenter ascribes this occurrence to *rigor mortis.* **Post-mortem rigidity** is due to coagulation of the myosin, and is attended by chemical changes analogous to those taking place during contraction.

OTHER CAUSES INFLUENCING TEMPERATURE.

Although fever is the **principal** state in which disturbance of the heat-regulating mechanism occurs, yet there are **others** which determine alterations in the temperature. Comparatively rarely does the loss surpass the production of heat. In disorders marked by **diminished action** of the heart and lungs, with consequent lowered rate of oxygenation, the generation of heat falls sensibly below the normal standard. **A type** of this condition is seen in the affection known as *morbus cœruleus*, or **cyanosis,** dependent upon congenital malformation of the heart and great vessels, or very extensive organic disease of the lungs. **Oxygenation** is extremely **defective,** the blood is loaded with carbonic acid, and the source of **heat production** is thus directly **limited.** In this disease the temperature may fall as low as 78° F.

* Landois and Stirling.

In **cholera,** the drain of watery, albuminous, and saline constituents from the blood almost prevents circulation, the secretions become suppressed, venous stagnation gives rise to cholera cyanosis, the **skin** is of corpse-like coldness, the **respiration** irregular and sighing; the radial **pulse** disappears. The **expired air** gives a sensation of cold to the hand held before the mouth, and, tested by the thermometer, has been found as low as 76° or 80° F. A most significant fact is that it contains **more oxygen** and **less carbonic acid** than in health, a striking evidence of the cessation of the interchanges which should take place during respiration. A rectal temperature of no more than 67° F. has been observed in some cases. **Simple jaundice** is characterized by retardation of the action of the heart and lungs; the pulse sinks to 50, or less, and in one case Frerichs could count but 21. The diminution of respiratory movements is not in the same ratio, the proportion of respiration to circulation being as one to three. The **temperature** does not usually manifest any decided decline, but has been found, with a pulse of 52, to fall to 96.4° F. In **diabetes mellitus,** unless phthisis co-exist, the respiration is rendered somewhat more slow, though the pulse manifests no characteristic alteration. It is, however, more frequently retarded than hastened unless a complication intervene to render it more rapid. The **temperature** is very commonly **lowered.** In this disease the thermometer has very frequently been observed to stand at 95° or 96° F.

The **profound depression** of nervous energy occasioned by **shock** displays itself in a pallid and cold skin, cold extremities, sunken features, more or less complete unconsciousness; shallow, irregular respiration; small, unequal, and tremulous pulse, together with an actual loss of temperature of 2° or more. The shock consecutive to **perforation** in **typhoid** fever is sufficient to reduce the temperature several degrees. Liebermeister has seen it fall 5½° F. from this accident. The **intestinal hæmorrhage** of the same disease is also followed by a sudden depression of temperature. We have seen it brought as low as 94° F. by this complication. **Loss of blood** after an operation is followed by reduction of heat. A sudden severe hæmorrhage, as from an accidental wound, may effect a decline of from 1° to 3°, owing to deficiency of oxygenation. The **transfusion** of blood, on the other hand, occasions an elevation.

Some **maladies** of the **nervous system** are attended by a remarkable **reduction** of warmth. Loewenhardt found in paralytic and insane patients, several weeks before death, a rectal temperature of 30° C. to 31° C. (86° to 87.8° F.), while Bechterew speaks of a case of paralytic **dementia** in which the rectal temperature before death was lowered to 27.5° C. (81.5° F.).

Certain **drugs influence temperature.** This is due, for the most part,

to the fact that they check chemical transformation; some, in addition, promote the loss of heat. Among such agents of frequent use may be instanced chloroform, alcohol, and opium. Carbonic acid and carbonic oxide, by inhibiting muscular action, cause a fall of temperature. The mercury has been seen to sink to 24° C. (75.2° F.) in profound alcoholic intoxication. In this case recovery occurred.

PHYSIOLOGICAL EFFECTS OF COLD.

The blood is the vehicle by which heat is conveyed to the surface of the body and exposed in the capillary vessels of the lungs and skin to contact with the atmospheric air. It parts with a greater or lesser portion of its heat, according to the impulse emitted from the nervous centre governing the capacity of the cutaneous vessels, and, therefore, the amount of blood contained in them and the possible loss of heat by radiation. A close relation subsists between the nutritive and calorific properties of the blood. The delicate adjustment of the circulation renders the effect of exposure to moderate degrees of temperature somewhat paradoxical in appearance; for a moderately high temperature is productive of refrigeration, while moderate depression increases the bodily warmth. Thus if, from one point of view, the application of heat or cold may be said to defeat its own object, yet, with a knowledge of the fact, we may take advantage of it in therapeusis. Gentle warmth, by quickening the action of the heart and lungs, propels the blood more rapidly to the surface, favoring evaporation, radiation, and conduction. The influence of cold leads to the reverse consequences, into the description of which it is necessary that we should enter with some detail.

The contact of cold air is reported to the cerebrum, and through the reflex agency of the vasomotor centre the superficial vessels are constringed. The muscular fibres of the skin also become slightly contracted, which condition materially aids in lessening the cutaneous circulation. M. Ch. Féré, in recent researches,* has ascertained that exposure of the naked body to so high a temperature as 18° to 20° C. (64.4° to 68° F.) occasions a considerable rise of arterial pressure, amounting to two hundred or three hundred grammes, as measured by the sphygmométre of M. Bloch. The blood, driven from the skin, is thrown back upon the deeper structures, and the heat generated is retained. The retained heat, however, soon relaxes the cutaneous spasm and a freshened circulation promotes expenditure. The influence of a lowered temperature (40° to 50° F.) produces a sensation of cold, due to sudden abstraction of surface heat; the skin is contracted, bloodless, and rugose. Involuntary muscular activity is excited, as seen in shivering, and one is impelled to

* Comptes Rendus des Séances de la Société de Biologie, July 6, 1889.

the execution of voluntary movements in order to generate warmth. So great an effect has cold upon the **calibre of vessels** that M. Féré found the radial artery strongly contracted and notably smaller than that of the opposite limb when the hand had been immersed in ice-cold water. On the other hand, heat production is increased by cold. A more active **consumption of oxygen** is excited, and carbonic acid is more abundantly evolved. **Cold,** in other words, **increases tissue-change,** which, in its turn, maintains or even slightly raises the general temperature of the body. M. Féré mentions a curious fact which seems to have escaped prior observation. When the increase of arterial tension exceeded two hundred or three hundred grammes, it caused a considerable **hypersecretion** from the perspiratory **glands** of the **axilla,** amounting, in some cases, to an exceedingly abundant flow. This author concludes that the reflex vaso-constrictor influence of cold does not affect the surface uniformly.

When **rabbits** are submitted to the action of a low temperature an extreme retardation of the pulse occurs, the blood-pressure falls, the movements of respiration become slow and shallow, stimulation of the pneumogastric is without effect, asphyxia causes neither increased blood-pressure nor spasms, the urine is suppressed, the liver congested, and the intestines cannot be excited to movement. The retina becomes pale, signs of paralysis appear, the blood-corpuscles are destroyed, and the animal at last dies in **convulsions.**

The experiments made by M. Chossat upon birds and mammals emphatically illustrate the **relationship** between **alimentation** and the generation of **heat.** In **birds,** when deprived of food and drink, the temperature fell gradually day by day until the limit of endurance was reached with combustion of nearly all the fatty tissue. Heat was then lost very rapidly, the thermometer fell from hour to hour, and whereas the total loss from the beginning until the last day had been 4.5°, upon the day of death a loss of 25° took place. During the first half or two-thirds of this period the birds did not betray much uneasiness. They then became restless and continued so until the heat began to be lost rapidly, when the agitation was succeeded by stupor and the animals evinced a desire to sleep. They made no attempt to fly, remained in any position in which they might be placed ; respiration became slower and slower, and the pupils dilated. Sometimes death was quiet and in other cases was preceded by convulsions.

Nevertheless, of a number subjected to **artificial heat,** even upon the last day, most were **resuscitated,** muscular power returned, the temperature rose, and they flew about the room. If the supply of heat was maintained and food administered, most recovered. But it was not until they were able to digest food that the power of heat production

returned. Until that time external warmth was necessary, and if that were removed too soon the temperature again fell and death took place. We are, therefore, warranted in saying that **death** from **starvation** is, in reality, death from **cold.**

Extreme cold, long continued, diminishes temperature chiefly by conduction, even if the heat production be increased. A very low temperature exercises a powerfully depressant effect upon the **nervous system. Tetanus**—or, at least, tetanoid contraction—was seen by Dr. E. K. Kane as the result of the intense cold of an Arctic winter.

MODES OF APPLYING HEAT AND COLD.

The principal manner in which varying degrees of temperature are brought to bear upon the body for the purpose of securing palliative or curative results is by the **use of water.** This method is generally convenient and is easily regulated. The virtues of water have already been discussed under the head of Hydro-Therapeutics. In consideration, however, of the comfort of the patient, inefficiency of attendants, or invincible prejudice of relatives, we are not infrequently led to recommend the employment of **dry applications.** In some cases, indeed, the use of dry heat or cold may be esteemed the more valuable.

An obvious mode of subjecting an individual to the influence of a desired temperature is by regulation of the heat of the **room** which he occupies. Diseases attended by deficient calorifying power require a rather elevated temperature, while the reverse is the case in maladies marked by any considerable degree of fever. More emphatically is this true of the management of fever during the **summer season.** The discomfort of fever may be to some extent relieved by **accessory measures,** which tend to cool the air of the apartment. Light covering, admission of fresh air, provision for proper ventilation, the melting of blocks of ice in the room, cloths wet in ice-water and hung up near an open window, the atomization of ice-water, cologne-water, or other volatile refrigerant, as suggested by Prof. J. M. Da Costa, contribute to the success of other means adopted. The rapid evaporation of **volatile substances,** such as ether or rhigolene, abstracts heat locally, and, secondarily, produces a general effect upon the system. A **freezing mixture** of salt and ice may often be advantageously employed.

Heat may be **communicated** by means of bags filled with hot sand or ashes, hot bricks, sad-irons, or earthen plates wrapped around with flannel cloths, bottles containing hot water, or simply by heated woolen cloths laid upon the body. In some parts of Germany peat-baths are used by pulverizing the peat and mixing it into a sort of paste with water. This can be applied at various temperatures. Hot **sand-baths,**

in which the patient is buried to the neck, and **mud-baths,** have been brought into requisition. Currents of **hot air,** also, may be directed upon different regions. The **local effect** of moist heat is very commonly secured by means of **poultices** made of various materials.

A very excellent mode of applying heat, in suitable cases, is by simple exposure to the warmth of the sun,—the **sun-bath,** as it has been called. This is an admirable and powerful agency in the promotion of nutrition. Its efficacy is of a **complex** nature, combining the effects of heat, light, and the chemical influence of the actinic rays. A **solarium,** that is, a room open to the sunlight, provided with glass partitions which may be closed in cold weather, is a suitable addition to every hospital. "**Firing**" is a kind of mild cauterization performed by passing a heated iron lightly and rapidly over the surface, which is protected by a fold or two of woolen cloth.

Cold, when applied topically, has a benumbing effect upon the sensory nerves. **Local anæsthesia** may be produced by the ether or rhigolene spray, by carbon disulphide, and by a freezing mixture of ice and salt.

In close relationship with the study of heat and cold stand the subjects of **diet, clothing,** and **climate.** These are, therefore, eminently proper themes for discussion in a broad survey of the therapy of temperature. Each element of our **food** has its definite heat value, and the experiments upon animals referred to in a preceding paragraph demonstrate the vital importance of **rational alimentation** in states characterized by a defective power of heat generation. The subject of fit **clothing,** sufficiently warm without being oppressive from its weight, bulk, or faulty arrangement, is one which demands consideration in the case of **chronic invalids** with depressed vital activities, very **young** and **aged** persons, and in **convalescents.** It is, however, too wide a topic for notice under the present head. The hygienic and remedial virtues of climate depend largely, of course, upon their temperature. The influence of climate upon disease in general, and the **selection of climates** adapted to special cases of disease, are problems which should engage the closest attention.

THERAPY. DISEASES IN WHICH HEAT IS BENEFICIAL.

Warm applications to the chest are very serviceable in **acute pneumonia.** It is a common practice to envelop the entire chest in a **jacket-poultice,** covered with a layer of oiled silk in order to retain the heat and held in position by means of tapes. Such applications, it is claimed, are derivative to the circulation, promote perspiration, and relieve pain, but it must be borne in mind that this measure is a **two-edged sword.** The least dereliction on the part of the nurse in attending to their

removal at the proper time, the slightest change in the temperature of the room, or a perceptible draught of cold air, may be followed by a chill, while the exertion demanded is likely to tax severely the patient's strength. They should be used as **hot** as can be borne, and **renewed** as soon as they become cool. They are also occasionally of advantage **in** other intrathoracic inflammatory affections.

During **convalescence** gentle exercise out-of-doors and exposure **to** warmth of the sun expedite recovery. Warmth to the chest is especially valuable in the acute inflammatory diseases of young children. Acute **pulmonary œdema** is an alarming condition in which the capillaries of the lungs become frightfully engorged. It is liable to occur in the course of chronic Bright's disease or organic heart affections, particularly in mitral obstruction or regurgitation. The **hot-air bath,** in this complication, is an efficient addition to other measures employed. Hot poultices around the neck serve a good purpose temporarily in **membranous croup** or **diphtheria.** The inhalation of **warm vapor** is also to be recommended in these grave maladies. Poultices likewise afford relief in **tonsillitis,** but only when accompanied by considerable tumefaction of the cervical glands, and suppuration is inevitable. The painful swelling and tension of the parotid gland in **mumps** is relieved by the use of warm, dry, flannel cloths or layers of carded cotton.

The nervous as well as the inflammatory disorders of the tissues of the throat and chest are treated with good result by means of heat. The shrill or barking recurrent cough which occurs independent of lesion in chlorotic or hysterical females—**nervous cough,** as it is aptly termed—seems unamenable to direct treatment unless by means of some severe mental impression or shock. Among the indirect measures which may eventually be attended by success, and which are rather of a corroborative hygienic than purely medicinal character, fresh air and sunlight deserve mention. **Solar heat,** if not immoderate, will favor nutrition of the nervous system, upon some vice of which the neurotic malady depends. Precisely the same remark may be made concerning **nervous aphonia,** which, however, is often signally and suddenly relieved by electrical treatment. Sunshine is one of the tonic measures proper to be used in the endeavor to maintain the nutrition of the heart-muscle in compensatory hypertrophy of the heart.

Elevated temperature is more notably beneficial, however, in the alleviation of painful **affections** of the **chest.** Excluding the pain of inflammation or pressure, **pain** is always expressive of **depressed nutrition** of nervous tissue. It may be due to the sudden or the long-continued impression of cold, to an insufficient or unfit supply of pabulum, to overstrain of nerve-centres, to a deleterious composition of the blood, to nu-

tritive failure accompanying old age, or, in short, to any cause which depresses the vitality of nervous structure. The application of heat lulls the pain in the diseased fibres and contributes to improvement of the conditions from which it originates. In **angina pectoris,** associated with lesions of the heart or its vessels, nothing but palliation can be expected from any plan of treatment. Warm, revulsive applications placed over the heart are, however, capable of affording some mitigation of the intense agony characteristic of the affection, and should be conjoined with other remedial agents. The firing process is capable of diminishing the suffering incident to **intercostal neuralgia** or pleurodynia.

Quite lately the **inhalation** of **hot air** has been highly extolled in the treatment of **pulmonary tuberculosis.** Heat is an excellent and manageable disinfectant. An exposure of one hour to a temperature of 100° to 130° C. (212° to 266° F.) has been found by Schill and Fischer to destroy the infective property of tuberculous sputum. Prompted by a consideration of this fact, Weigert suggested the use of hot air in phthisis in the hope of destroying the bacillus tuberculosis *in situ*. Air may be respired at a very high temperature without any inconvenience. Several observers have made trial of the proposed method, but the **reports** are **not,** upon the whole, **favorable.** Kohlschütter administered air of 482° to 572° F. to numerous patients. As, however, he found that the temperature of expired air was no more than 110° F. it is very improbable that it is able to exert a noxious influence upon bacilli imbedded in the lung-tissue. It may prove of limited advantage in **sterilizing** the bronchial secretions.

The **testimony** of those who have employed the inhalations is that the air, to be efficient, should be raised at least to 320° F. Air at 350° to 360° F. may often cause improvement, an increase of body-weight, a strengthened action of heart and lungs, a decrease of expectoration and the number of bacilli present in the sputum. Dr. George G. Sears, of Boston, reports* that the practice seems to increase the liability to **pulmonary hæmorrhage,** that in two cases he was obliged to abandon it on account of its producing sore mouth and loss of weight, while in a few instances there was some amelioration of the general condition, but the **physical signs** remained **unaltered.** This authority could detect no decrease of bacilli. Much heat must be lost by radiation before the air reaches the lips and in evaporating the moisture of the air-passages. In fact, Dr. Sears is disposed to ascribe any improvement which took place to the result of expansion of the lungs and not to the temperature of the respired air.

In chronic **dysentery,** and in convalescence from acute dysentery, external warmth affords considerable relief. In the course of the acute

* Boston Medical and Surgical Journal, July 11, 1889.

attack it is well to cover the abdomen with a light poultice. In acute **enteritis,** especially when the patient is a child, warm applications, such as poultices or spongiopiline, diminish the pain. They prove of avail, also, in cases of **intestinal colic.** In **cholera infantum** the exhausting drain brings on a stage of collapse; hence, one of the indications of treatment is to supply from without the warmth which the system has no power of generating, and which it is absolutely necessary should be maintained. The collapse stage of **Asiatic cholera,** described in a foregoing paragraph, marked by absolute depression of temperature, demands hot applications. Bottles filled with hot water should surround the body and the patient be covered with warm blankets. The local action of heat diminishes the severe suffering occasioned by passage of a **biliary** or **renal stone.** The acute inflammatory affections of the **abdominal** and **pelvic** tissues and viscera—peritonitis, perihepatitis, perinephritis, pelvic cellulitis, metritis, ovaritis, and cystitis—are benefited by the use of heat, dry or moist. In **menorrhagia** hot applications to the lumbar region will sometimes succeed in checking the flow. A hot poultice to the hypogastrium will often allay the irritability of the bladder to which females are so liable.

Neuralgic pain, in this as well as other portions of the body, is advantageously treated by heat. Gastralgia, enteralgia, lumbo-abdominal neuralgia, and sciatica indicate, amongst other remedies, the external employment of warmth. "Firing," performed along the course of the nerve, is a serviceable method, and conjoins the impression of milder counter-irritation. Extending the same principles to lowered nutrition of the cord, experience teaches that **dry heat** to the spine is an efficacious measure in **spinal anæmia.** Tic douloureux, or other form of neuralgia of the fifth nerve, and migraine may also be enumerated among the varieties of nerve-āche to which dry heat is applicable.

The **uræmia** attendant upon acute yellow atrophy of the liver will suggest to us the trial of the hot-air bath in order to favor the elimination of urea. It must be stated, however, that in this fatal disorder, when once established, our efforts serve only to possibly prolong but not to save life. In the uræmia due to acute nephritis, chronic Bright's disease, interference with the eliminative function of the kidneys by specific fevers, morbid growths, or degenerative processes, heat in some form should be used with a view to promoting **substitutive excretion** through the skin. Heat is an available resource in the treatment of **anasarca,** favoring elimination of the water. The lowered temperature of **diabetes mellitus** demands attention. The patient should be warmly clad, and should be directed to avail himself, as far as practicable, of the advantages of solar heat. Removal from a cold, moist, or variable **climate** to one

that is warm and dry, or a voyage in Southern seas, are measures which have been found advantageous. Precautions against **taking cold** should be rigidly observed in **diabetes insipidus,** since much heat is consumed in warming the enormous quantities of liquid ingested, and the temperature is apt to fall below the normal.

Although during the cold stage of **malaria** the internal temperature is augmented, yet the sensations of the patient are relieved by surrounding him with hot bottles or bricks wrapped in flannel, and by covering him with warm bed-clothing until the chill has passed. These measures are more urgently demanded in the severe forms of malarial poisoning known as **pernicious intermittent** or **remittent** fever. The algid variety of this affection is marked by extreme coldness of the surface. The patient should be surrounded by hot applications and quinine given hypodermatically in large doses. Life is seldom sustained beyond a second paroxysm. Our aim, therefore, is to avoid a recurrence. Heat is the most effective means at our disposal in the treatment of **intermittent hæmaturia.** The patient instinctively seeks his bed and covers himself with blankets. In **yellow fever** the congestion of important viscera, the depressed vitality and temperature of the third stage, together with the occurrence of uræmia, indicate the application of heat to the skin in order to fulfill the double purpose of stimulating the circulation and removing toxic materials.

Dry heat to the affected joints is often productive of comfort to patients suffering with acute **inflammatory rheumatism.** The heat may be applied by means of flannel cloths or cotton-wool. A hot-air chamber may also be advantageously employed, while in other cases poultices may be preferred. **Chronic rheumatism** is notoriously unmanageable. There is no doubt, however, that the arthritic pains of chronic rheumatism are often soothed by the local use of dry heat in some form. The patients love to sit over the fire and are better in summer than in winter. They require to be warmly clad, and are often more benefited by change of climate than any kind of medicinal treatment. Warm applications yield relief in **muscular rheumatism,** and the surface should be kept at a comfortable warmth by means of suitable clothing. Warmth to the affected joints assuages the pain of **gout.** Some improvement may be effected in **rheumatoid arthritis** by the persistent employment of heat. Either moist or dry heat may be used, or both alternately.

The skin requires sedulous care in **syphilis.** The sudden impression of damp cold is followed by the intensification of symptoms, and we may deduce hence the practical conclusion that, in addition to warm baths, the skin should in the interim be sufficiently protected by warm clothing. This remark especially applies to the colder part of the year or to cold

climates. The patient should strictly avoid exposure to draughts. The unfortunate **inheritors of syphilis** begin life burdened with defects of nutrition. The conservation of bodily warmth, therefore, is a matter which should duly engage the attention of the physician. Moderate heat is likewise requisite to the nutrition of those who suffer from **scrofula.** Maintenance of the bodily warmth is demanded in many **morbid states,** associated with reduced power of heat generation, as severe dyspepsia, anæmia, chlorosis, neurasthenia, jaundice, and cancer.

Both **infancy** and **old age** are characterized by a deficient power of resistance to the effects of low temperature. The aged require warm garments and apartments and receive benefit from sun-baths. The failure is more pronounced in the case of prematurely-born babes. The temperature of a seven-months' child, two or three hours after birth, was found by Dr. W. Edwards to be only 89.6° F. Warm surroundings should come to the aid of the defective power. An apparatus termed a **couveuse** has been devised, adapted particularly to the use of orphan and foundling asylums. It consists essentially of a double-walled bath-tub of copper. Hot water is poured between the walls and the temperature maintained at 100° F.

Profound **shock** effects positive reduction of temperature. The circulation and respiration are equally depressed. It is necessary in this condition to **communicate heat** from without, since the system is no longer able to generate it. The action of the heart and lungs is stimulated by high temperature.

High degrees of heat are **counter-irritant, cauterant, styptic,** and **escharotic.** A cauterant action may be secured by concentrating the rays of the sun by means of a double convex lens. A smart impression of heat upon the external surface allays pain and draws, or derives, a current of nervous influence and blood to the periphery. The **nutritive states** of deeper parts are influenced by **reflex action** or by alterations in the distribution of the blood. Judiciously applied in the congestive stage, counter-irritation, reinforced by other measures, may suffice to arrest the development of an inflammatory process. After the subsidence of an inflammation, it is efficacious in promoting the **absorption** of exudation material. It is serviceable, again, in converting a chronic into an acute inflammation. The former, pursuing a sluggish course, manifests little or no tendency to improvement; the latter, raging vigorously for a time, terminates in recovery.

Active inflammation due to cauterization is destructive to irritable, unhealthy granulations, and, therefore, contributes to the cicatrization of irritable or **chronic ulcers. Chronic inflammation** often gives rise to proliferation or thickening, which, in extreme cases, may attain the pro-

portions of **morbid growths.** Consequences of this kind are seen in old fistulæ, in some cases of endometritis, in nasal hypertrophies, etc. Inflammatory softening may lead to **hæmorrhage** from rupture or ulceration of blood-vessels. If this occur in accessible situations **cauterization** is at once an effective and cleanly styptic. The vessels are obliterated, and their orifices seared by the formation of an eschar. There is no better method of checking the **hæmorrhage,** often excessive, of **uterine cancer.** An eschar upon the surface will exert a profound influence upon chronic inflammation of deep structures, chronic synovitis, sciatica, chronic myelitis, etc.

Counter-irritation and mild cauterization may be effected by "firing." An escharotic result is produced by what is styled the **actual cautery.** The tissue is destroyed by means of iron raised to a white heat. The **objection** to the actual cautery as a remedy against hæmorrhage is, that when the eschar has separated **recurrent bleeding** is liable to take place. Of late years heat has been generally obtained through the instrumentality of **electricity.**

Hot applications in the incipiency of a **superficial inflammation** are often sufficient to arrest the disease. At a later stage, when stasis, transudation, and exudation have occurred, heat **promotes suppuration.**

CONTRA-INDICATIONS TO THE USE OF HEAT.

In all cases in which increased cardiac activity may be a **source of danger** heat is to be avoided or used with extreme caution. **Hæmorrhage** from vessels or surfaces inaccessible to direct surgical procedures requires cold applications and surroundings. Again, whenever a forcible impulse of the heart might lead to rupture of a vessel, elevation of temperature is manifestly improper. This is the case whenever **atheroma** is present. If the cerebral vessels be brittle, exposure to undue heat might result in an attack of **apoplexy.** One who suffers from **aneurism,** especially thoracic aneurism, should shun the effect of a very high temperature. In apoplexy heat should never be applied to the head, though it may be of service to use cold to the head and heat to the feet and legs, in the effort to divert the circulation from the brain.

DISEASES IN WHICH COLD IS BENEFICIAL.

Acute inflammatory affections are relieved by cold as well as by heat. Pneumonia, pleurisy. bronchitis, endocarditis, pericarditis, have all been treated with gratifying results by means of cold applications to the chest. It is well for us to guide ourselves by the physique and the sensations of the patient. Persons of **delicate** constitution should receive

heat. Among **robust** individuals **some** will derive more advantage from **hot** and **others** from **cold** applications. **Prejudice,** as has been intimated, will not infrequently dictate our selection.

Niemeyer highly praises the application of cold to the chest in inflammatory disorders of the thoracic viscera. In the paroxysms of **spasmodic asthma** the patient obtains some alleviation of his distress by the inhalation of cold air. In **hæmorrhage** from the **lungs** cold plays an important part in our management. The air of the room should be kept cool, if possible; the chest should be subjected to the influence of cold, while ice should be swallowed. The same measures prove effective in cases of **hæmorrhage** from the **stomach** due to ulcer or cancer. Cold to the neck is a valuable resource in **spasmodic croup.** Swallowing pieces of ice will sometimes diminish the pain of **angina pectoris.** Cold, conveyed by means of bladders filled with ice, mitigates the pain caused by biliary or renal **calculus.** The burning pain sometimes produced by **tumor** of the kidney or bladder may be relieved by an ice-bag, as recommended by Prout.

The abstraction of **heat in fever** is principally effected by means of water, and has been discussed under the head of Hydro-Therapeutics. We may aid in obtaining the same result by the maintenance of a rather low temperature in the sick-room. Acute **peritonitis** is benefited by the use of cold to the abdomen. Since this disease is most frequently the result of septic infection, the reduction of the systemic temperature becomes an important question. For that reason cold rather than warmth is to be advocated in its treatment.

Congestive headache is afforded much relief by the application of cold. We have already adverted to the principles which should govern our employment of temperature in cases of apoplexy. Cold to the spine by means of ether-spray, as suggested by Dr. Benjamin W. Richardson, has been found efficacious in **chorea.**

Some improvement may be effected in **leukæmia** by cold applications. Niemeyer saw temporary gain result from cold-water treatment. Some practitioners advise injections of ergot or arsenic into the enlarged spleen, an ice-bag being laid over the spleen after each injection. But almost any mode of treatment seems hopeless in this disease. In **obesity** it is advisable to avoid high temperature. The patient's room should be only of moderate warmth, and cold water should be used for bathing.

Acute articular rheumatism is generally, perhaps, treated by warm applications. Nevertheless, in a certain proportion of cases the inflammation in the joints is reduced by the use of cold. In these cases marked diminution of pain occurs.

Surgeons meet with disordered intellection, as a consequence of severe injuries, such as compound fractures, extensive lacerated wounds, extensive burns, etc. **Traumatic delirium,** as this condition is called, is not infrequently so prominent a symptom as to call for measures adapted to its relief. Among these, cold to the head and warmth to the feet have proved of service.

As cold promotes constructive metamorphosis, it stimulates the **appetite** and assists **digestion.** This is the effect of cold bathing and cold climates. Bodily and mental vigor are promoted. Yet, continued exposure to excessive cold is powerfully depressant.

The application of heat in conditions of **lowered vitality** is stimulant. The principal organs are assisted to resume their functions. But, continued too long, it reduces the strength. This effect is produced by hot bathing and hot climates.

CONTRA-INDICATIONS TO THE USE OF COLD.

Warmth needs to be very carefully maintained in **old people.** They lack, as has been stated, in resistance to lowered temperature; they are sensitive to sudden falls of the thermometer; their nutritive processes are carried on slowly: they should, therefore, be warmly clothed. But, on the other hand, the elasticity and contractility of their tissues are impaired; atheromatous changes are common: **caution** should, therefore, be exercised in subjecting the aged to a high degree of heat, from the fear of inducing **apoplexy** or **heart failure.** **Infants** and **very young children** should be strictly guarded against the influence of reduced temperature. Cold is apt to have a deleterious effect in dilatation of the heart or **valvular disease,** accompanied with dilatation.

Avoidance of cold is especially to be enjoined upon recovery from acute desquamative nephritis. A sudden chill of the surface may very readily provoke a **recurrence** of the inflammation. **Intermittent hæmaturia** is very closely connected with atmospheric conditions. Exposure to cold, especially damp cold, is quickly followed by the attack. This fact suggests the care which should be exercised. Whenever possible, the patient should make a **change of climate.**

In surgical affections **harm** may doubtless be done by too prolonged use of cold applications. It is quite possible to reduce the circulation through a part sufficiently to produce **gangrene** of the edges of a wound. As granulations require warmth for their development, cold is **not adapted** to the treatment of **open wounds**; nor do cold dressings favor the occurrence of primary adhesion.

MINERAL WATERS.

GENERAL CONSIDERATIONS.—Unfortunately for the public, the medical profession has placed too much reliance upon the presence of mineral constituents in various waters used for therapeutic effect, as it is now known that many drinking-waters contain a larger proportion of such ingredients than those which are highly lauded as mineral waters. Doubtless much depends upon the **relative proportions** of these ingredients and upon the temperature, but, on the other hand, it is claimed that some of those recognized as the most valuable—like Vichy, for example—derive their activity from the presence of **microbes,** which it has been suggested may in some occult way **modify digestion** when introduced into the alimentary canal. That bottled mineral waters are less efficient than those drunk at the fountain is admitted, and as an explanation of this inferiority we are confronted with the suggestion that the original microbes are destroyed and others take their place, while the bottled water is further contaminated by the enzymes thus formed.

But all waters contain these micro-organisms to a greater or less extent, and we know that no special precautions are taken for the purpose of **sterilizing** this product, hence a consideration of the therapeutic value of so-called mineral waters must be limited to their use in the immediate vicinity of the wells. In view of this tendency to deterioration from the presence of micro-organisms, it has lately been suggested that waters having a definite chemical composition might be **prepared artificially,** and we must admit that many of the imitations now on the market apparently confirm the wisdom of this course. By the adoption of appropriate antiseptic precautions no objections could be offered on the score of bacterial infection, and patients could then expect to receive quite as much benefit from the judicious use of mineral waters as if they journeyed to distant parts; but of course this leaves out of the question entirely the benefits to be derived from **change of climate** and social environment, and above all the advantages attending upon dietetic changes. We must pass over in this connection the **fanciful claims** advocated on the part of interested stockholders, who would have us believe that the waters in which they are interested possess certain peculiar properties not vouchsafed to less favored mortals. Speculative investors will scarcely be able at the present day to find many willing to adopt the notion that the heat of a certain spring is different from ordinary heat, or that the water possesses any peculiar electrical property, or the still more absurd theory that, like the serum of the blood, the water

carries with it a certain life, which causes all other waters, when compared with it, to sink into insignificance.

All **classifications** must of necessity be artificial and open to serious objections as studied from different stand-points, owing to the fact that it is often impossible to determine the most important therapeutic agent; hence, a subdivision upon any basis of this sort would be comparatively useless. The most convenient arrangement for a work of this character is naturally suggested by the general character of the water itself. Thus, **chalybeate** waters would form a separate group from those distinctly **sulphurous**; in addition, we have **saline** and **alkaline**, with their sub-varieties; but this leaves out of consideration a considerable number of waters which are fully entitled to notice, and such will therefore appear as **unclassified.** It must not be inferred, however, that all of them are so different from each other that no classification is possible, but rather that the scope of this work does not admit of the consideration of their various properties in detail. Many of them, in fact, appear to possess therapeutic value in inverse proportion to the amount of mineral constituents contained.

Much has been said of the **temperature** of many of these waters, and there is a general belief that thermal waters possess properties more valuable than others, but of this there is room for doubt. In addition to the **climatic changes** which the patient undergoes, it should be noted that there is a decided modification of the **hygienic** regulations imposed at many of the springs, and to this, along with the **dietetic** changes, we may ascribe a share of the good results which follow a visit at the different resorts. This matter is so forcibly and delightfully described by Mr. Ernest Hart, the energetic editor of the *British Medical Journal*, that we quote from his facile pen the following regarding his impressions of Carlsbad: "It affords a well-regulated life in the open air amidst the fir-woods; it supplies an interval of complete removal from the rush, hurry, and excitement in the course of a busy life; it provides the best of all cures for mind and body,—pleasant scenery, wholesome diet, with the universal accompaniment of beautiful music, and with these what may be properly called a natural hydropathic treatment of copious draughts early in the day of hot water, sipped in moderate quantities at suitable intervals of time. There are very few forms of gastric, intestinal, renal, and nervous cases which are not capable of being benefited by such a treatment, even if that were not at all mineralized. It is thus that the most varied complaints and the most opposite morbid conditions are successfully treated by the **Carlsbad-cure.** As to the specific value of the saline constituents of the water, I profess an absolute skepticism of the value of the minute differences which it is attempted to establish

between one spout and another; but to the virtues of the Carlsbad-cure, as a whole, under the conditions, and in the way in which it is carried out, after more than one experience, I am a convinced convert." Mr. Hart facetiously refers to it as a water-cure, a rest-cure, an air-cure, a music-cure, an exercise-cure, a mind-cure, and a body-cure, and is disposed to regard a Carlsbad-cure as a very complex therapeutic agent.

A patient, after having experienced the influences of so many and multifarious cures, upon returning to his home and regular employment, should not immediately discontinue the system which has afforded him benefit, but will find it advantageous to conform to the methods in spirit, if not in letter, which have shown their value; it will be advisable also to continue the use of the water or some suitable substitute.

Mineral waters are so widely distributed that in a short sketch a complete description will not be expected, and many of the springs must of necessity pass unnoticed. The necessity for this observation will be apparent when it is stated that in the United States alone more than eight thousand have already been located, although not more than a few hundred of this immense number of different waters have been analyzed.

CHALYBEATE WATERS.

As a rule, the **quantity of iron** contained in these waters is quite small, and is generally the carbonate or sulphate in combination with carbonic acid, the latter being supposed to exercise an important influence when taken into the system. A want of iron in the blood would naturally point to its use in chlorosis and anæmia and in all those conditions attendant thereon, as general debility, weakness after fever, and from loss of blood; but while iron is admitted to be a constituent of the blood, only about one grain daily is taken with the ordinary food. Chalybeate waters are useful in amenorrhœa and other menstrual derangements in women, as well as sterility, seminal emissions, and hypochondria in men. Where a tendency to hæmorrhage exists those iron waters impregnated with alum should be selected by preference. These are styptic and astringent, but others which contain chloride of sodium, and are known as bitter waters, are purgative.

American.

Baily Springs, Alabama.—Contain oxide of iron, with carbonates of potassium, sodium and magnesium, and carbonic-acid gas.

Bath Alum, Virginia.—(Temperature, 110° F.). Contain a larger proportion of iron than Rockbridge Alum, as well as free sulphuric acid and sulphates, with protoxide of iron. Valuable in gout, rheumatism, and liver affections, and the neuralgiæ incident thereto.

Warm Springs, Bath County, Va.—(Temperature, 98° F.). Used in similar cases as

the Bath Alum Springs, although the latter, it is claimed, have a greater value in kidney affections.

Cooper's Well, *Mississippi*.—Advocated for the treatment of chronic diarrhœa, certain cases of dropsy, and in blood dyscrasiæ, as anæmia, etc.

Oak Orchard Acid, *New York*.—Useful in diseases of the skin, ulcers, passive hæmorrhage, etc. Contains ten grains of free sulphuric acid to the pint.

Rawley Springs, *Virginia*.—Contain carbonate of lithia, manganese, magnesia, and lime, but the most important ingredient is the carbonate of iron. A useful tonic in anæmia, etc.

Rockbridge Alum Springs, *Virginia*.—These waters are highly recommended for the treatment of scrofula, chronic diarrhœa, etc.

Sweet Chalybeate Springs, *Virginia*.—Contain iron, with sulphates and chlorides, together with a considerable quantity of carbonic-acid gas, and has a peculiar, sweetish taste. Therapy the same as that of Rawley Springs.

European.

Alexisbad, *Germany*.—Contains carbonic-acid gas, iron, and manganese in large quantity.

Bascombe, *Bournemouth*, *England*.—Contains iron in combination with carbonic acid.

Bocklet, *near Kissengen*.—Altitude, 600 feet. Contains carbonate of iron, and is laxative; useful in anæmic conditions, and has some reputation as a ladies' bath.

Dorton, *England*.—Contains iron sulphate, with carbonic acid, but is to be diluted before drinking.

Elster, *Saxony*.—Altitude, 1465 feet. Of the same character and used in the same cases as that of Bocklet.

Forges-les-Eaux, *France*.—Contains carbonate of iron and is laxative.

Franzensbad, *Bohemia*.—Altitude, 1293 feet. Much the same as that of Bocklet.

Griesbach, *Black Forest*.—Altitude, 1614 feet. Contains carbonate of iron and is laxative.

Hastings, *England*.—Contains sulphates of iron, lime, magnesia, and soda.

Homburg, *near Frankfort*.—Contains but a small quantity of carbonate of iron; is said to be useful in anæmic conditions and laxative.

La Malon, *Hérault*, *France*.—This is a warm spring (temperature, 88°), and is recommended in anæmic conditions; laxative.

Liebenstien, *North Germany*.—Altitude 911 feet. Contains carbonate of iron and is laxative.

Muspratt Spring, *Harrogate*, *England*.—Contains small quantity of carbonate of iron, with chlorides.

Petersthal, *Black Forest*.—Altitude, 1333 feet. Contains but a small quantity of carbonate of iron; laxative.

Pyrmont, *Germany*.—Altitude, 404 feet. These waters contain carbonic acid, and sulphates and carbonates of iron, lime, soda, and magnesia, and are used in anæmic conditions.

Recoaro, *North Italy*.—Altitude, 1463 feet. Contains carbonate of iron and is laxative; used in anæmic conditions.

Rippoldsau, *Black Forest*.—Altitude, 1886 feet. These waters are used in anæmia, chlorosis, etc. They contain a small quantity of carbonate of iron and are laxative.

Sandrock, *Isle of Wight*.—These waters are what may be termed aluminous chalybeate, and must be diluted before drinking.

Schwalbach, *Nassau*.—Altitude, 900 feet. Useful in anæmic conditions; laxative, and highly regarded as a ladies' bath.

Spa, *Belgium*.—Altitude, 1000 feet. Much the same as Schwalbach.

St. Moritz, *Engadine*, *Switzerland*.—Altitude, 5464 feet. Much sought for on account of the air. It is useful in anæmia, and acts as a laxative.

Tunbridge Wells, *England*.—Altitude, 289 feet. These waters are deficient in carbonic acid as compared with many others, but are still of value in anæmia.

SULPHUROUS WATERS.

Waters having the odor of hydrosulphuric acid are generally believed to be modified as to character by the presence of organic matters in the soil. Some contain sulphides, with but little mineral matter, while others contain sodium chloride or sulphate of lime.

Since the introduction of Bergeon's method of rectal insufflation, the **toxic** character of **hydrogen sulphide** has become more apparent to the medical profession, although it is not believed that this gas exists in mineral waters in sufficient quantity or amount to cause untoward symptoms. Nothing is known positively concerning the effect of this gas upon the system, except that it has in a moderate degree the property of influencing tissue-change, and counteracting to a limited extent the destructive metamorphosis connected with the breaking down of cell growth, such as may be witnessed in the progress of tuberculosis.

These waters are of **decided benefit** in the treatment of syphilitic affections; in the depression attending upon metallic poisoning, and that which is connected with chronic rheumatism and gout. Malarial disorders, and the accompanying diseases of the liver and spleen, with disturbances in the portal circulation, are all favorably modified by the judicious use of sulphur waters, both internally and in the form of baths. Persons suffering from **lead-poisoning,** upon taking hot baths in sulphur water, find the skin on coming out of the bath covered with a blackish-brown coating, which is in reality the insoluble sulphide of lead. This shows that the metal has reached the skin, and, in a short time, with the continuance of the baths, the characteristic toxic effects begin to disappear. The Mount Clemens (Michigan) Mineral Springs are notably efficient in this respect, as well as in the removal of syphilitic infection.

That iron tends to accumulate in the liver we have most conclusive evidence, but we have no positive knowledge that the sulphur has any influence in promoting its removal, although doubtless much benefit is derived from drinking such waters, containing as they do the chlorides of sodium and magnesium. In **diseases** of the **skin,** sulphur waters have long been highly esteemed, and they certainly do produce appreciable effects in all those cases characterized by the condition known as sub-oxidation, and probably a small portion of the gas is absorbed by the skin.

Not only in the cases mentioned, but also in **pulmonary affections,** sulphur waters occupy an important position in therapeutics. In the latter case, they have been much used in this country and abroad in the form of inhalation, which is effected by reducing the water to a vapor by means of certain mechanical appliances.

Two peculiar substances, named respectively *glarin* and *baregin*, are found in these waters, both in Europe and America. The **typical sulphur water** is probably to be found in that of Aix-la-Chapelle, the temperature of which is 131° to 140° F.; the altitude of the spring is but five hundred and thirty-four feet. Some of these waters are cold; others are warm or hot; and in the following list, so far as could be learned, the temperature of the thermal springs is given.

American.

Indiana, . . { Blue Lick Springs, Indian Springs, West Baden Springs.

These springs contain both sulphuretted hydrogen and carbonic-acid gas, and have more than a local reputation.

Kentucky, . { Big Bone Springs, Lower Blue Lick Springs, Upper Blue Lick Springs, Paroquet Springs.

These waters are aperient and alterative, containing large quantities of sulphuretted hydrogen and chloride of sodium.

Crab Orchard Springs.—Contain Glauber's salt, with some sulphuretted hydrogen, and are of decided benefit in the treatment of disorders of the intestinal tract characterized by deficient secretion. They have been recommended in a great number of diseases, and the water is now placed upon the market in a concentrated form, which adds to the convenience of administration.

Michigan, *Alpena Well.*—Contains but a small proportion of chloride of sodium, though it is rich in sulphuretted hydrogen.

New York, ... { Avon Springs, Sharon Springs.

These waters contain but a small quantity of sulphuretted hydrogen, but are rich in sulphate of lime.

Virginia, . { Green Brier Sulphur Springs, Red Sulphur Springs, Salt Sulphur Springs, Yellow Sulphur Springs.

These waters contain carbonic-acid gas and sulphuretted hydrogen, with sulphates, chlorides, etc., and are useful in scrofula, syphilis, and other blood diseases.

Virginia, . . White Sulphur Springs.

These waters are much the same as those just mentioned. They have recently been studied by Van Bibber, who recommends both a two and a four weeks' plan for the treatment of malarial affections, and, in addition to the use of the water, suitable exercise should be adopted.

European.

Aix-les-Bains, *Savoy.*—Altitude, 765 feet; temperature, 108.5° F.

Aix-la-Chapelle, *Germany.*—Altitude, 534 feet; temperature, 131° to 140° F.

Amélie-les-Bains, *Pyrenees.*—Altitude, 810 feet; temperature, 87° to 147° F.

Archena, *Spain.*—Temperature, 126° F.

Baden, *near Vienna.*—Temperature, 95° to 115° F.

Baréges, *Pyrenees.*—Altitude, 4100 feet; temperature, 113° F.

Cauterets, *Pyrenees.*—Altitude, 3254 feet; temperature, 71° to 134° F.

Challes, *Savoy.*—Altitude, 900 feet.

Eaux Bonnes, *Pyrenees.* — Altitude, 2400 feet; temperature, 90.5° F.

Eilsen, *Schaumburg-Lippe.*

Engbien, *France.*

Gurnigel, *Switzerland.* — Altitude, 3600 feet.

Harrogate, *England.*

Hercules Bad, *Banat.*—Altitude 500 feet; temperature, 110° F.

Llandrindod, *Wales.*

Lavey, *Rhone Valley.*—Altitude, 1350 feet; temperature, 92° to 113° F.

Leuk, *Switzerland.*—Altitude, 3593 feet.

Lisdunvarnia, *Ireland.*

Luchon, *Pyrenees.*—Altitude, 2000 feet; temperature, 133.5° F.

Meinberg, *Lippe-Detmold.*

Moffatt, *Scotland.*

Schinznach, *Switzerland.*—Altitude, 1060 feet; temperature, 80° to 92° F.

Strathpeffer, *Scotland.*

Uriage, *Isere*, *France.*—Altitude, 1500 feet.

ALKALINE WATERS.

Like the other waters considered, alkaline waters contain an excess of carbonic acid, and, in addition, a considerable quantity of carbonate or bicarbonate of soda, and act as **efficient diuretics.** The value of alkalies has already been referred to (see Oxygen, page 233), but, inasmuch as alkalies have the effect of retarding digestion, some discrimination must be exercised as to the time of their exhibition. Given after meals, while the secretion of gastric juice is thereby increased, its activity is lessened. This assumption is, however, more or less theoretical, and does not always obtain in practice, and especially is this the case where the alkaline treatment seems to be indicated. A condition of **hyperacidity** is present, and the judicious exhibition of alkaline waters will often accomplish most remarkable results.

Undoubtedly, a too free use of alkalies will have a tendency to produce a lowered condition of the system, but the amount of such ingredients found in mineral waters generally is insufficient to produce **untoward effects** unless used to excess. The **carbonates** are neutralized in the stomach and changed into the chloride of sodium, and, while the first effect is to dilute or destroy the gastric juice, the increased gastric secretion sufficiently compensates for any loss in this direction. In some, carbonate of soda is the principle agent; in others, we find sodium chloride in addition, while others still contain sulphates.

The **special indication** for the exhibition of alkaline waters may be said to be in the treatment of gastro-intestinal disorders, including, of course, in this category, affections of the liver. Indirectly they modify the genito-urinary apparatus. Again, they are also believed to be of decided benefit in cases of incipient phthisis, as already mentioned in the section upon oxygen, and in cutaneous affections dependent upon digestive disturbances. Those containing a notable proportion of sulphates are known as **bitter waters**; they act as purgatives, the best known of the class probably being Hunyadi, and this class of waters has been largely imitated. The larger proportion of them are cold, but some, like Carlsbad, are thermal.

Alkaline mineral waters are **especially valuable** in the treatment of lithæmia and the succeeding neurasthenia, affections which appear to be rapidly increasing, and it is doubtful if there are to be found any more efficient alkaline waters than those of our own country. The public will require to be educated, however, and greater attention will be demanded on the part of those having in charge patients who are to be subjected to this treatment, with a view to having some methodical plan adopted which can be readily carried out.

Vichy and Vals waters are said by Prosner and Goldenberg to be useful in the treatment of uric acid diathesis, on account, probably, of the sodium bicarbonate they contain, and, as all persons cannot take advantage of this water, it has been recommended that the bicarbonate of soda might be substituted with equal benefit. Whatever renders the urine alkaline, while increasing the flow and lessening the specific gravity, will contribute to prevent the formation of renal calculi and subsequent attacks of gout. Probably no combination for this purpose offers better promise of success than lithium bromide in combination with potassium citrate, to which the reader is referred.

American.

Berkley Springs, Virginia.—Simple alkaline.

Bethesda Springs, Wisconsin. — These springs are justly celebrated for their medicinal properties, and have been long used in the treatment of diabetes mellitus, renal calculi, cystitis, and as a diuretic in albuminuria and dropsy.

Bladon Springs, Alabama.—These waters are carbonated alkaline, with carbonic-acid gas, etc., and a trace of sulphuretted hydrogen.

Bromine-Arsenic Springs (*Thompson's*) *North Carolina.*—Alkaline saline; contain lithium, iodine, etc., and are said to be useful in rheumatism, dyspepsia, and all classes of kidney diseases.

Buffalo Lithia Springs, Virginia.—Simple alkaline; an efficient remedy for uric acid diathesis, gouty and rheumatic affections.

California Seltzer Springs.—Saline alkaline; similar to Congress Springs, California.

Capon Springs, West Virginia. — These waters are alkaline, with traces of iodine and bromine, and are situated in a picturesque and delightful mountainous region.

Congress Springs, California.—Saline alkaline, with iron, etc., and are highly charged with carbonic-acid gas.

Hot Springs, Bath County, Virginia.—These are alkaline-saline thermal waters (temperature 100° to 108° F.). It may be mentioned that this is one of the famous springs of this class in America, the water being used both internally and for bathing, very complete arrangements having been made for the latter purpose.

[*Warm Springs*, situated in the same county, are similar to the Hot Springs, though of a somewhat lower temperature.]

Perry Springs, Illinois.—Alkaline saline.

St. Louis Springs, Michigan.—Contain carbonate of soda, magnesia, iron, and lime sulphates, etc., and are claimed to be magnetic, but a personal inspection negatives any such claim, although in years past the waters have enjoyed great popularity.

European.

Bilin, Bohemia.—Used in the treatment of gastro-intestinal disorders.

Carlsbad, Bohemia.—Altitude, 1214 feet; temperature, 85° to 166° F. There are seventeen springs, varying in temperature as above indicated. They contain sulphate, carbonate, and chloride of sodium, besides sulphate of potassium, and carbonate of calcium. Like all these springs, Carlsbad is recommended for hepatic and gastro-intestinal troubles, and the usual skin affections accompanying them. Both biliary and renal calculi are favorably acted upon by these waters, and it is said that diabetes has shown itself amenable to their influence.

Bormio, Southern Alps.—Altitude, 4460 feet; temperature, 102° F. Alkaline saline; contains chloride of sodium and magnesium, and an alkaline sulphate. Has been used in rheumatism, and accompanying neuralgia

and paralysis, and in such catarrhal affections as modify the pulmonary and gastro-intestinal tracts. It is said to be especially valuable in chronic skin diseases.

Bourbole, Auvergne.—Altitude, 2800 feet; temperature, 107° to 125° F. Used in scrofula, bone diseases, and in cutaneous affections.

Elster, Saxony.—Altitude, 1460 feet. Contains sulphate of soda, and is useful in a variety of disorders, including abdominal disorders and diseases of females.

Ems, Nassau.—Temperature, 85° to 115° F. These waters are used especially in diseases of the mucous membranes and in the treatment of female complaints.

Franzensbad, Bohemia.—Altitude, 1293 feet. Contains sulphate of soda, and is also classed with chalybeates as a ladies' bath.

Gleichenberg, Styria.—The waters of this spring contain carbonate and chloride of sodium, and carbonate of magnesia highly charged with carbonic-acid gas.

Ischia, Italy.—Temperature, 170° F. Used mostly for the treatment of rheumatism and female complaints.

La Malon, France.—Temperature, 97° F. These waters are used as a nervous sedative, and have attained a wide reputation.

Lubatschowitz, Moravia.—Altitude, 1600 feet. Contain both carbonate and chloride of sodium.

Marienbad, Bohemia.—Altitude, 1012 feet. Contain soda sulphate and carbonate, and recommended in obesity. These waters are sometimes classed as saline.

Mount Doré, Auvergne.—Altitude, 3300 feet; temperature, 100° to 114° F. Used in pulmonary affections, asthma, and chronic laryngitis.

Neuenahr, Rhineland.—Said to be especially valuable in the treatment of diabetes.

Rippoldsau Waters.—Useful in anæmia, neuralgia, and nervous disorders.

Rogat, Auvergne.—Altitude, 1400 feet; temperature, 80° to 95° F. Used successfully in the treatment of anæmia and cutaneous disorders.

Saltzbrunn, Upper Silesia.—These waters are rich in carbonate of soda.

Tarasp, Lower Engadine.—Altitude, 4000 feet. Contains sulphate and carbonate of soda, and is believed to have decided action upon the abdominal viscera.

Tönnistein, Rhine Valley.—Antacid and tonic.

Vals, France.—Useful in catarrhal affections of stomach and bowels, renal and biliary calculi and diabetes.

Vichy, France.—Temperature, 105° F. Much the same as Vals.

Vidago, Portugal.—Called the Portuguese Vichy.

SALINE WATERS.

Many of the saline waters are classed with the alkaline group, as the former contain important constituents which belong to the latter. **Salines include** strictly only those waters in which sodium chloride is the predominant ingredient, ordinary sea-water being the representative of the class; but ordinary sea-water contains much less sodium chloride than many of the mineral waters of this group. Like the others, carbonic acid is found in considerable quantities in all those which have gained popularity. They also contain the usual chlorides of lime and magnesia, together with some bromine, lithium, and iodine, and occasionally some iron. They are used for drinking and for bathing, and are found both hot and cold.

The **therapeutical indications** for the employment of salines may be summed up as follows: Gastro-intestinal disorders characterized by a torpid condition of the glandular system; hepatic and portal congestion,

and the usual pelvic derangements dependent thereon, such as uterine engorgement, ovarian neuralgia so-called, and hæmorrhoids. Gout, rheumatism, and rheumatoid arthritis are also included in the list of affections amenable to the influence of saline mineral waters.

We have already noted that carbonates taken into the stomach are changed into chlorides, and act as diuretics, and it is here to be noted that when salt is increased over the usual daily allowance it may have an **antiseptic influence** owing to the chlorine set free, but that it does have decided **aperient effects** there is no question. Even when taken in considerable quantity, it has been estimated that saline waters add but little more than one-third more to the daily amount taken into the system with food, which has been set down at about three hundred grains, but its action when taken into the stomach fasting may differ materially from that which takes place when digestion is going on.

The rôle which **salt** plays in the **economy** is that of a **stimulant.** From the time it enters the stomach until excreted by the kidneys, the function of every organ which it enters is exalted; the tissues with which it comes into contact undergo more active changes, while its presence favors the removal of waste products. The therapeutic range of saline and alkaline-saline mineral waters has not been fairly estimated; at least, not in this country.

The successful treatment of **Bright's disease** by the use of sodium chloride on the part of Memminger prompted Dr. Austin Flint, of New York, to prepare a formula which should embrace the more important organic salts of the blood, containing a small quantity of reduced iron and an excess of sodium chloride, as follows:—

℞ Sodii chloridi, ...	℥iij.
Potassii chloridi, ...	gr. ix.
Potassii sulph., ...	gr. vj.
Potassii carb., ...	gr. iij.
Sodii carb., ...	gr. xxxvj.
Magnesii carb., ...	gr. iij.
Calcis phos. præcip., ...	℥ss.
Calcis carb., ...	gr. iij.
Ferri redacti, ...	gr. xxvij.
Ferri carb., ...	gr. iij.

M. In capsulæ no. lx.
Sig.: Two capsules three times a day.

This saline chalybeate has given good results in Bright's disease, and in **simple anæmia,** when indicated, the showing has been quite remarkable.

While upon this subject, **Ebstein's theory** may be referred to, viz.: That glycogen and diastatic ferments are present in the circulating fluids

and tissues, and the latter acting upon the former results in the **production of sugar.** This action may be temporary or permanent, the latter constituting **diabetes.** Carlsbad water, which contains carbonic acid in considerable quantity, becomes then an efficient remedy, owing to the supposed prophylactic power of the carbonic acid against those diastatic changes.

Ordinary **sea-water baths** have been found efficient in the treatment of scrofulous affections, so that a number of establishments for the purpose of affording children the benefits have within a few years been located along the Mediterranean coast. There is such an institution at Cette, France, and at Cannes a winter asylum has been opened, where a prolonged stay is recommended, but not to the exclusion of suitable medical treatment, such as cod-liver oil, phosphate of lime, salted milk, and infusion of hops. This method of treatment is highly recommended for tuberculosis.

American.

Arrowhead Springs, *California*.—Temperature, 140° to 193° F. Contain sulphates of potash, soda, lime and magnesia, chloride of sodium, and other important ingredients, together with a small quantity of free sulphuretted hydrogen.

Ballston Spa, *New York*.—These waters are similar to those of Saratoga, and are used in the same class of affections.

Bedford Springs, *Pennsylvania*.—Contain sulphate of magnesia, with carbonate of iron, and are by some classed as a chalybeate. They possess diuretic properties, are laxative, and are useful in anæmia and kidney troubles, as calculous affections, etc.

Caledonia Springs, *Ontario*, *Canada*.—These are common salt springs, and have been used in rheumatism and gout.

Catalina Island Springs, *California*.—According to the analysis of McCarty, these waters are especially active salines. They contain chloride of sodium and magnesium, with sulphates, etc., and magnesium carbonate.

Crab Orchard, *Kentucky*.—These springs have already been referred to under the head of Sulphurous Waters. Glauber's salt is the most active ingredient.

Glenwood Springs, *Colorado*.—Altitude, 5000 feet; temperature, 138° F. These waters contain a large proportion of chloride of sodium, with sulphate and carbonate of lime, and resemble in many respects sea-water. The action of the water is that of an alterative, and, conjoined with an unusually dry atmosphere and delightful climate, it is said to be especially efficacious in chronic rheumatic affections, and in general debility.

Las Vegas, *New Mexico*.—Altitude, 12,000 feet; temperature, 140° F. Contains carbonate, sulphate, and chloride of sodium, the latter in large proportion, and is regarded as of value in pulmonary troubles.

Midland Springs, *Michigan*. — Contain Glauber's salt.

Saratoga Springs, *New York*.—The Saratoga springs vary somewhat in composition and therapy, but the greater number contain chlorides in abundance along with carbonic acid. Their value is much the same as many others of this class. They are indicated in functional disorders due to engorgement of the abdominal viscera, and in chronic diseases.

Spring Lake Well, *Michigan*.—The uses are similar to the waters of St. Catharine's, Canada.

St. Catharine's, *Ontario*, *Canada*.—These waters contain a large percentage of chloride of sodium as well as other chlorides, potassium, calcium, magnesium, and must first be diluted before using internally. Gout, chronic rheumatism, and abdominal disorders are modified favorably by a course of baths; strumous affections and neuralgia are also benefited.

European.

Albano, Italy. — Temperature, 185° F. Mud-baths are much in favor, the waters also being used for bathing purposes.

Acqui, Northern Italy.—Temperature, 169° F. Greatly prized in the treatment of rheumatism, and the bath-deposit is also used as a poultice.

Adelheidsquelle, Bavaria.—Altitude, 2000 feet. Used with success in chronic rheumatism, gout, and uterine affections.

Baden-Baden.—Altitude, 616 feet; temperature, 156° F. Useful in gout and rheumatic affections; it is a mild saline, and popular for bathing purposes.

Balaruc, Southern France.—Temperature, 116° F. Especially advocated for the treatment of paralysis; useful also in rheumatism and malaria.

Bex, Rhone Valley.—Altitude, 1400 feet. Useful in chronic affections, rheumatism, uterine diseases, etc.

Bourbonne, Haute-Marne.—Temperature, 114° to 149° F. These waters have been highly lauded for the removal of malarial cachexia; they are also useful in the treatment of neuralgia and rheumatism.

Brides, Savoy.—Altitude, 1700 feet: temperature, 95° F. Used in abdominal plethora and obesity.

Caldas de Mombuy, near Barcelona, Spain.—Temperature, 153° to 158° F. Used in rheumatism, sciatica, and old injuries; said to be very efficacious.

Castrocaro, Tuscany.—Advocated for the relief of chronic diseases.

Cestona, Gripuzcoa, Spain.—Temperature, 88° to 94° F. These waters are supposed to affect the liver, and have been found valuable in rheumatism, indigestion, and in chronic bronchitis.

Cheltenham, England.—Saline aperient, and contains carbonic acid. Useful in hepatic affections and constipation.

Droitwich, near Worcester.—These waters are highly charged with sodium chloride, having about eight times as much as ordinary sea-water, and have been used with satisfaction in chronic affections like rheumatism and in uterine disorders.

Friedrichshall, Germany. — An aperient bitter water; useful in abdominal affections accompanied with obstruction of the portal circulation. They contain carbonic-acid gas, and are laxative.

Hall, Tyrol.—Altitude, 1700 feet. Contain a large percentage of sodium chloride, and have been used in uterine affections, rheumatism, scrofula, etc.

Homburg, near Frankfort.—Altitude, 600 feet. Useful in hepatic affections, mild cases; in chlorosis, gout, chronic constipation, and even in hysteria. They contain a large quantity of carbonic acid.

Ischl, Austria.—Altitude, 1440 feet. Water is highly charged with sodium chloride; used in chronic diseases, including rheumatism and female complaints.

Kissingen, Bavaria.—Essentially the same as the waters of Homburg and Soden. Used also in albuminuria and diabetes.

Kreutznach, near Bingen.—Altitude, 285 feet. Possesses valuable alterative properties, and is used in strumous and syphilitic diseases, and in diseases of the skin. The treatment consists largely in bathing.

Leamington, England.—Saline alkaline; used in acid dyspepsia, constipation, etc. Although called chalybeate, it contains a considerable amount of chloride of sodium, and in addition thereto the chlorides of potassium, calcium, and magnesium, and a number of other important ingredients. It is especially recommended by Garrod in the gouty diathesis, and in liver troubles with sluggish condition of the circulation.

Nauheim, Wettereau.—Temperature, 80° to 103° F. These waters have about the same proportion of chloride of sodium as ordinary sea-water, and are especially advocated in locomotor ataxia.

Pyrmont, North Germany.—In addition to the iron spring, there is also a salt spring.

Rehme, Westphalia.—Temperature, 92° F. Especially recommended in locomotor ataxia, but is also used in chronic diseases, scrofula, etc.

Reichenhall, near Saltzburg, Germany.—Altitude, 1800 feet. Used in scrofula, chronic diseases, rheumatism, etc.

Rheinfeld, Switzerland. — These waters contain over three hundred parts of sodium chloride to one thousand parts, and are used principally in scrofulous affections.

Salins, Moutiers, Savoy.—Altitude, 1480

feet; temperature, 96° F. Has a reputation for the treatment of sexual disorders, anæmia, scrofula, etc.

Salzungen, North Germany. — Contains two hundred and fifty-six parts of chloride of sodium to one thousand parts, and has been used with success in the treatment of rheumatism and other similar conditions.

Soden, near Frankfort.—Said to be especially valuable in throat troubles and phthisis, and, besides, the waters have been recommended for dyspepsia, anæmia, and scrofula.

Weisbaden, Nassau.—Temperature, 155° F. Used internally in dyspepsia and gout, but has a greater reputation as a bathing resort.

UNCLASSIFIED WATERS.

In concluding the section upon mineral waters it should be noted that the subject is by no means exhausted. The very large number of valuable **thermal springs** found in the western portion of the United States, to say nothing of those thermal waters which have been studied and now largely used in European countries, should be better understood by general practitioners. They could then take advantage of their presence by prescribing them for patients suffering from diseases which would be benefited from a course of baths or from the internal use of the water.

Space will not permit a detailed list of these springs, but it may be stated that for the most part these unclassified waters are used as baths, and in European countries they have attained wide celebrity. Quite a number are found in Switzerland, some in Germany, southern France, and England, the waters of which vary from 85° to 140° F., but they do not excel in quality and composition those which are found in abundance in our own country. This will appear the more forcible when it is stated that many of these waters have even less mineral constituents than those used for culinary and drinking purposes.

The student is, therefore, referred to the article Hydro-Therapeutics for a more detailed exposition of the value of hot and cold baths as a means of maintaining and regaining health. These unclassified waters in this and also in other countries are generally found in picturesque and almost inaccessible regions, and the change of scene and surroundings may exercise an important rejuvenating influence.

METALLO-THERAPY.

Although not yet reduced to the scientific basis of a system, the use of metals for the purpose of curing disease has held a place in the minds of mankind from the earliest times. The following which the method now has is such that only good will result from an investigation, since none but **actual results** will be taken into consideration in estimating the proper

position of the plan as a therapeutic agent. As at present conducted, it is confined to the **local use** of **metals,** either in the form of disks or coins, which are attached to each other and applied around the affected limb, or the disks are simply placed upon the affected area, and it is claimed from these apparently useless applications that not only **paralyses** of **hysterical** origin may be promptly relieved, but also those due to **organic** lesion; but it should be mentioned that more success has been reported from abroad than has been witnessed on this side of the Atlantic,—a fact which may be due to the character of the population. This brings us to speak of the value of the so-called "impression" in all such cases,—something which is often omitted when taking into consideration the probable results of any form of treatment.

The **impression** produced upon the patient is calculated by some as of the greatest importance in the ordinary administration of medicines, and some go so far as to assert that many of the later methods introduced into our practice, like electricity, the inhalation of oxygen, and other methods which might be mentioned, are calculated to attract the attention of patients to such an extent that their **maladies** will, in a measure, be **forgotten,** if they are not actually relieved. The suggestion is put forward that Hypnotism and Suggestion are but other methods of treatment which are just across the line of demarcation, and that the only difference between the two is that in the latter method the patient is sent across the boundary-line through the magnetic (?) influence of the operator. Confirmatory evidence in this direction is furnished by the extraordinary success which attended the introduction of the so-called "**tractors**" of Perkins, of Connecticut, not only in this country, but abroad, persons of the highest standing and reputation giving most laudatory testimonials concerning the great cures which had been effected by this means.

Now, these tractors of Dr. Perkins's invention were prepared from different kinds of metal, and were so made that they could be applied along the affected area, when the pain, insensibility, weakness, hyperæsthesia, and what not, would almost instantly disappear, and the sufferer proclaimed himself as having been miraculously restored to health. A damper, however, was cast upon the method when it was shown that **wooden tractors** were equally as efficacious as the metal ones, and finally the whole system was abandoned, because there was no one who could explain the scientific basis of the cures, and neither could intelligent practitioners be influenced to lend themselves to charlatanry. That our countrymen are not wholly free from the machinations which may be brought about by mental influences is a fact which requires no demonstration, as the marked success which has attended the introduction of

various **chimerical theories** relating to healing is a sufficient indorsement of the impressionability of a considerable portion of the American people, but, in respect to the effects of metals, they appear to have either withstood the manipulations, or the manipulators have been signally incompetent.

The **theories** which have been **advanced** to account for the benefits resulting from the application of metal disks to affected tissues and organs, when considered from a scientific stand-point, must be admitted to be lame and unsatisfactory, although they have been presented by men of science whose conclusions are entitled to great weight. The subject was first presented to the attention of the Sociétié de Biologiè, of Paris, by Burk, in his inaugural thesis, in 1851, although but little attention was attracted by it. A committee, however, was finally appointed to investigate the matter, and in 1879 a report appeared which not only confirmed what had been claimed by Burk, but which also embraced some new and important discoveries that had come under the observation of the committee during the investigation. As the most active member of that committee, Charcot was under the impression that the action of the metals might be, and probably was, due to the **electricity** which was developed, and it was demonstrated that a current actually presented itself strong enough to be measured; but, when it was found by the investigations of Bennett, of England, that pieces of wood or other substance would produce effects equally as satisfactory as the metals, and that even so trifling a thing as a **handkerchief** was quite sufficient for the purpose, there was a hesitancy in accepting the conclusions of Charcot and his associates. English observers were therefore disposed to discredit the electrical phenomena, and sought to **substitute** for it the theory of "expectant attention" on the part of the patient. There is a **general belief,** whether warranted or not, that any measure of this kind will produce an effect altogether out of proportion to the curative properties of the application as usually understood, and it must be admitted that the mere application of anything of the kind has a tendency to mystify and excite the mental activity of the patient; but it is claimed on the part of those who have given the matter attention that in a number of instances all modifying circumstances of this character have been eliminated.

A **magnet** has also been used for the same purpose as the disks, but the use of magnets has not been attended with better results than that of the simple metal, and, in addition, there have been decided indications that some patients were subject to one metal while they were uninfluenced by any other, although some were influenced by two, but more by one than the other. The **proper metal** having been found which affects the disease by external application, that substance is **used internally,** and it is said

the effects are all that could be expected. What is probably more to the point is that these earlier statements have been confirmed by observers in England, Italy, and in Germany, although in this country the method has not yet met with the success which is claimed for it abroad.

A notable fact in this connection should be mentioned, namely, the phenomenon of "**transfer,**" by which is understood the power of these applications to transfer the strength from an unaffected part to the diseased portion. Thus, when one of the legs or arms is suffering from paralysis, the selected metal having removed the disease, it will be found that the strength of the other member has been lessened. Another interesting observation which has been noted is, that after a cure has been effected, if the same metal be reapplied, the paralysis returns. But a method has been discovered by which the **relief** may be made **permanent.** It consists in having a second metal superimposed upon the curative metal for a short time, when, it is said, no further difficulty will be experienced, although this does not correspond with the statement that to remove the disease the subsequent internal administration of the metal becomes necessary. Neither are we enlightened as to the additions which are required when only a piece of wood is used for the purpose, nor when so simple a remedy is used as an ordinary handkerchief.

How do these metals act? That is a question which is yet to be solved, although we are placed in a favorable position for considering the matter by the **information** that when these applications have been made, whether the cases are of hysterical origin, or whether the paralyses are due to organic lesion, the temperature is promptly increased in the affected part, and the sensibility as well as the muscular power is restored. This leads us to the **conclusion** that the imagination has more or less to do with the therapy, as it is a well-known fact in medical practice that when the mind is concentrated upon any special part of the organism, there is an increased determination of blood to the part, and of course that brings with it increased warmth, but it is doubtful if such a change would be of sufficient amount to restore sensibility and power to paralyzed muscles which had followed upon organic lesion of the brain.

In conclusion, we must be permitted to suggest that the notions heretofore held in regard to the value of metals for the relief of disease applied in the manner just indicated are **somewhat fanciful,** to say the least, and are on a par with other extraordinary announcements which have but a transitory existence. That a man will become powerful from eating the hearts of lions, or that he will be enabled to see better at night by swallowing the eyes of weasels, is an exploded superstition. The suggestions are entertaining, just as it is pleasant to speak of an obsolete idea concerning spontaneous generation, namely, that in order to generate

mice it was only necessary to get some corn. put it in a sack. and stow it away in a dark place for ten to fourteen days, when, lo! the mice had fully developed.

TRANSFUSION.

Transfusion is a method of procedure which is not altogether confined to the surgeon, as it frequently falls to the lot of the physician to adopt the plan in cases of **emergency,** as well as in those cases where the system has become debilitated from continued illness. For the most part, however, the practice of transfusion is limited to the treatment of the effects following upon **hæmorrhage,** which may attend upon serious injury, post-partum hæmorrhage, or the hæmorrhage which occasionally occurs in connection with abortion or miscarriage, and that form which is supposed to be due to a diathesis. There are times, however, when it will be advisable to introduce a quantity of blood of a healthy character into the tissues of those who are sufferers from **functional diseases,** in which the ordinary treatment has failed to afford relief. Exhausted conditions of the system have been met in various ways with a view to supply the economy with something which would quickly be transferred into the circulating fluid, and which might be expected to add to its nutritive character. With this object in view it has been recommended that the blood of the ox should be taken internally, and to those who are so fastidious that such form of nutriment would be objectionable its use by **enemata** has been suggested, and the practice is not without its advantages, although many practitioners are unwilling to give the matter personal attention, because they regard the method as of doubtful value.

As generally practiced, **transfusion** consists in the introduction of a quantity of blood into the veins of the patients for the accidents already mentioned, and may be either **mediate** or **immediate.** By the first method the blood to be used is first withdrawn from the donor, when by means of a suitable instrument the same is introduced into the veins of the patient. In these days of antiseptics the foregoing statement will appear somewhat indefinite, but it seems almost unnecessary to say that proper **antiseptic precautions** should be observed throughout the entire proceedings. Attention should also be given to the general health of the donor, and especially is this necessary when it is remembered that operations of this character are liable to be attended with unfortunate results to the patient should there be any **specific history,** and, in view of the possible microbic origin of other diseases, this suggestion becomes still of greater importance and significance.

By the second process a communication is made directly between donor and receiver, by which the blood flows from the veins of one into the other, the principal guide to the discontinuance of the operation being the improvement in the condition of the sufferer.

By the first method an opportunity is permitted for defibrinating the blood, and from an extended investigation of reports covering the practice there seems to be an agreement that defibrinated blood has shown a larger proportion of recoveries than when used in the pure state. When the latter is introduced into the circulation the greatest care is necessary to prevent the **coagulation** of the liquid and the subsequent formation of clots in the circulation, and at all times is it necessary to guard against the **entrance of air** into the circulation,—a circumstance which would undoubtedly prove fatal to the patient.

This tendency of the blood to coagulate has caused some inquiry to be made concerning the need for the introduction of a nutrient fluid in cases of this character, and, while this view was strenuously upheld by practitioners and experimental physiologists ten years ago, other views now obtain, and the belief is now more general that such is not necessary, and that an **aseptic neutral fluid** is all that is required; but it should be noted that the temperature of the injected fluid should be a trifle higher than the temperature of the body as taken in the mouth, and there is a general agreement that 100° F. is as nearly correct as possible. A **saline solution** composed of less than 1 per cent. of common salt is **quite sufficient** for ordinary purposes of transfusion except those cases in which it is desired to increase or change the quality of the circulating fluid, as in the case of anæmia. Cases of the kind or of pernicious anæmia, to receive benefit from transfusion, we should expect would require actual blood rather than a saline solution. Cases of emergency will, of course, require different treatment from chronic cases, where benefit can be expected only when blood is used.

Other **substitutes** for blood have been suggested. **Milk** has been used successfully, and thus its safety demonstrated, but failures have also occurred in the cases where used, while besides there is a belief, whether well founded or not, that the use of milk has a tendency to cause the development of albuminuria. In cases where it is used, the recommendation is that it should be as nearly fresh from the cow as possible, that the temperature should be at 100° F., and that not more than from four to six ounces should be introduced into the circulation at one time,—an amount sufficient at any time.

Elsewhere we have indicated how practitioners might be able to improvise a substitute for transfusion* in the following language: Not

* Medical Bulletin, vol. xi, p. 55, 1889.

infrequently does it occur to the country practitioner that in cases of **hæmorrhage from any cause,** if transfusion were demanded or advisable, the proper apparatus and other paraphernalia are not at hand. Transfusion is probably more frequently demanded in emergency than at any other time, and that is often the time when it cannot be practiced. For a long time it was supposed that nothing but blood could be used for this purpose, but recently it has been practically demonstrated that a saline solution will answer every purpose, and accordingly the method has been so far modified that fresh blood is not a preliminary requirement. But even with this difficulty removed there will be times when this simple procedure—simple for the manipulator who has been fully initiated—cannot be carried out. Suppose, for example, we take a case like the following—one without blood, but carrying with it all the bad effects of loss of blood: A profuse and repeated choleriform discharge from the bowels. Given a patient on a hot summer day suffering from an attack of this nature, and the physician is called suddenly to find his patient in collapse. Hypodermatic injections of morphine and atropine may be of some value in controlling the action of the bowels for the time, but something is demanded for the benefit of the patient threatened with death from exhaustion and from shock.

Now, in a case of this kind, what could be more appropriate than an **enema of hot water,** to which has been added a sufficient quantity of laudanum to obtund the sensibility of the rectum. If to this we add a small quantity of common salt, the work is completed, and this can be repeated again and again without danger, and with the best possible results. Cases of the kind will occur to the practitioner far out in the country, at a farm-house, perhaps, when it is only necessary that he should use the ordinary syringe which every accoucheur should have in his bag. While watching his patient recover, he can send for the apparatus for transfusion, together with any assistance which may be deemed necessary.

In the case of **uterine hæmorrhage,** either before or after delivery, this may be adopted; or, in the case of injury, where great amounts of blood have been lost before the arrival of the physician, many lives might be saved annually from the bad effects following the shock of the injury and of the operation demanded, if this simple precaution were followed out. Possibly the method may be objected to on account of the **condition** of the **bowels**; it will be said that the lower bowel should be unloaded. That is not required, but by the use of an enema the bowels may be moved, when we have still a better opportunity for practicing the method, as they will then retain more water with less discomfort to the patient.

Arterial transfusion has been strongly indorsed by Schafer and others, as it is claimed that this method is most successful in laboratory experiments. Where this method is adopted, either the dorsal artery of the foot, or the radial or anterior tibial may be selected, and after exposure a small canula connecting with a rubber tube is inserted. To prevent the formation of clots and exclude air, it is advisable that the tube as well as the canula used should contain a saline solution of the proper temperature. **No force is required,** as the blood flows from the arteries of the donor no more rapidly than it is distributed throughout the tissues of the patient, and the claim is advanced that owing to this fact there is less danger of causing untoward symptoms by precipitating at one time a large amount of blood upon the heart. The danger from the formation of clots is certainly much less than when the blood is withdrawn and subjected to manipulative operations which add further to the dangers owing to the septic influences liable to take place from exposure.

Peritoneal transfusion has also been practiced, using for the purpose either pure or defibrinated blood, but the method, although successfully accomplished, is not without danger that cannot be avoided. Few surgeons at the present day would be willing to have four to six ounces of fluid introduced into the peritoneal cavity by means of an aspirator, providing other routes were practicable; but when so highly organized a product as blood is introduced in this manner, there is a strong probability that, unless the quantity be very small, at least a portion of it will act as a foreign body before absorption takes place. The wonderful achievements in surgery are doubtless due in a measure to the activity of the peritoneal tissues in absorbing and eliminating objectionable materials which are developed after operations, but we do not take kindly to the idea of trusting to these tissues for the performance of a **vicarious function** if it carries with it a degree of uncertainty such as has been pointed out.

The **apparatus required** for the performance of the operation when blood is to be transferred from one person to another by means of the veins, is not complicated. An ordinary small but well-made aspirator will answer every purpose, but the needles should be small. **Caution** is required that the direction of the needles should so correspond with the current of blood that no hindrance will occur in the regularity of the flow, and when no arrangement is attached that will enable the operator to measure the quantity a portion of the supply-tube should be of glass, by which the surgeon is enabled to estimate if he cannot measure the amount of blood which passes. In the absence of an instrument of this character, an ordinary small rubber syringe will do, but the valves must

first be removed. It should also be mentioned that the person supplying the blood is to be watched as well as the patient, as the mental effect together with the shock of the operation may be such that a stimulant may be required.

Emergency cases, however, demand **prompt attention,** and it may not be advisable to await the action of an enema or peritoneal injection, when venous or arterial transfusion may be temporarily delayed, and at such times it may be well for the operator to bear in mind the value of oxygen inhalations, but the position of the patient must never be forgotten. In the case of great loss of blood, the patient may insist upon maintaining the erect position, when the fright which attends the accident, together with the want of blood for the cerebral tissues, to say nothing of the difficulty with which the heart has to contend, may be sufficient to cause a serious shock.

HYPNOTISM AND SUGGESTION.

Hypnotism and Suggestion may be said to be relics of mesmerism, and to have been first placed upon a **scientific basis** through the efforts of Braid, a Manchester surgeon, although his investigations were wholly directed to the study of the various applications of mesmerism. For twenty-five years Liébault, of Nancy, has devoted his life to the relief of suffering by means of what is now called hypnotism, which is simply a modified form of Mesmer's methods freed from cunning and trickery, and the success which has attended upon his work and that of his followers has been such that the matter has been studied within late years by Charcot. The **object** of the **present reference** will be confined to a description of the methods pursued, the class of diseases to which it is adapted, together with some reference to the success which has attended upon its use; in addition to that which has just been stated, it will be interesting also to take into consideration some special features, closing with a brief note intended to present an estimate of the therapeutic value of the method as we now understand it, and the precautions which should be taken when it is determined to place a patient under this peculiar influence.

Like all other methods for the relief of disease, this has its opponents as well as defendants, but it cannot be successfully denied that all physicians practice the plan of suggestion, at least to a limited extent, although it must be admitted that often it is done unconsciously. The mere writing of a prescription and handing it to a patient implies a power or ability which places the person receiving it under obligations,

if it does not render him more susceptible to influences which the physician may wish to bring to bear upon him. Unwittingly we do more than that when we encourage those who may be afflicted with disease to keep up hope, by telling them that they are in a fair way toward recovery, although there is the difference that we do not undertake to place them under any occult influence, nor do we lead them to suppose that we can accomplish great results without the use of drugs or other remedies, —two very important changes from the ordinary methods of treatment.

The **phenomena** connected with the practice of hypnotism, it must be confessed, are peculiar, and, as has been remarked in the article upon metallo-therapy, it seems doubtful if such a practice will meet with supporters in this country, although we do not lack for those who claim to practice without the use of drugs. To be more definite, it may be stated that there are no inducements for any one to engage in a work of this kind in this country with the expectation that he can conduct it profitably and legitimately at the same time. The tendency of men who seek novel methods is to lend their attention to those who promise the most, and who have the least regard for truth,—matters upon which the legitimate practitioner is disposed to place a high estimate.

The **method** of **conducting** a *séance* is simplicity itself, and no one who is possessed of the peculiar power should be incapacitated on this score. The patient is seated in a comfortable chair, and is simply talked to by the operator,—first, with the view to impress upon him the idea of going to sleep, and after a time, when this has apparently been accomplished, the direction of the patient's thoughts is changed to a consideration of his maladies and the prospects of their disappearance. In putting the patient in a favorable or hypnotic condition, which is practically an **artificial sleep,** all that the operator does is to suggest incidents which occur in the usual way when a person is going to sleep, and no attention is at that time given to the malady. An epitome of the conversation which takes place in the ordinary tone of voice may be interesting. It is as follows: "You are beginning to feel drowsy, and your eyes look heavy; a feeling of general comfort is experienced, as if you were going to sleep, and gradually my voice seems farther and farther away, until now you can scarcely hear me talking. Your eyes are beginning to close." The operator touches the eyelids and presses them together, when he says, "There! your eyes are closed, and you are asleep." Then, directing the attention to the disease which may affect the patient, the physician may, if he thinks best, place his hands on the affected part or parts, and, in recounting all the troubles which it has brought, will suggest that shortly the disease may be made to disappear; that the pain and torture which has racked the patient for so many days will cease,

and in this way the patient may be brought back to a state of health which he had been accustomed to enjoy in childhood or manhood, and that his nights will be given up to peaceful slumbers instead of sieges of pain. After a period varying from five to fifteen minutes, more or less, a sharp word is spoken to the patient, or it may be accompanied by a movement of the hand or a touch upon some part of the person, and the patient is immediately aroused, and often expresses himself as feeling greatly benefited. Whether he is benefited or not, he comes on the day following and goes through a similar performance, and this is kept up from day to day.

The **class of persons** who are benefited by operations connected with hypnotism, as a rule, will be found to be recruited from every social ramification. Naturally, we would suppose that only those of feeble mental attainments would be susceptible to influences of the kind, or that the effects should be manifested largely in children, but it is said this is not actually the case. Both poor and rich are found to kneel at the shrine, and we cannot gainsay the fact that many are improved and others permanently cured by the procedure, and to this we shall now direct attention.

The **class of diseases** which yield to this form of treatment covers a wide range, but notably those of a chronic character, and it is even claimed that through its influence, under the direction of Charcot, many have been reformed and are now leading upright lives. Digestive troubles, nervous affections, and brain diseases are said to be amenable to treatment of this kind, and it is asserted that paralysis of hysterical origin and rheumatism are especially susceptible to treatment, but it is admitted that no effect is produced in the case of hystero-epilepsy. It will best serve our purpose to take up the list of affections *seriatim* which have been subjected to this treatment, and upon which reports of a general character have reached us. The **indications** for the adoption of hypnotism in cases of hysteria are not altogether clear, although it is admitted, as stated, that it is of service in certain forms of hysterical paralyses and convulsions of an hysterical character, as well as for the relief of hysterical amblyopia and amaurosis. In the treatment of chorea the benefits are said to be marked, but the manipulations must be continued for a considerable length of time,—several months. Delirium tremens and the alcohol habit are distinctly benefited, and if for no other reason we should be disposed to regard favorably the method.

The assertion that hypnotism exercises an important influence upon the genito-urinary system will not be surprising to those who are aware of the slight effects which may be productive of marked changes in both a direct and reflex manner. Cases of masturbation have been cured by

hypnotism, as well as incontinence of urine, and it is claimed that menstruation is modified by it to an extent which is often surprising, the periods becoming regular and the continuance of the molimen made to coincide with that of health. In the treatment of migraine, and other forms of neuralgia, the method is said to be only moderately successful, and probably we may account for this on the theory that cases of this nature are often due to an impoverished condition of the blood or to the condition of the liver, and of course nothing but increased nutrition can reach them. In parturition this method may be used instead of anæsthesia, but is not recommended when other modes are not contraindicated. The uterine contractions are not affected by hypnotism, nor are there any dangers from post-partum hæmorrhage, but no claim is set up that it will supersede chloroform and other anæsthetics. As an anæsthetic for surgical operations, while it can be used successfully, there does not seem to be any disposition on the part of the promoters to extend its usefulness in this special direction, and this is probably well for the plan, as, when too much is claimed, the resulting failure will more than counterbalance the good which has been accomplished.

The most **susceptible patients** are those who have been brought up under instructions to obey, and, whether strong or weak, whether the disease is acute or chronic, this is a matter of the first importance in taking into account the probable effect which the treatment will have. This is one of the **special features** to which we desire to call attention, and along with it may also be noted the fact that those who yield most readily to the action or influence range in **age** from three to thirteen years, and that lunatics and idiots are not sensibly affected by any influences which can be brought to bear upon them. The peculiar influence which the operator has over the actions of the patient may also be used for the purpose of preventing any bad effects following upon treatment, it is said, and this seems to be more wonderful than all the other features combined. While we can gravely consider the possibility of a physician affecting the mind of his patient so that he will be led toward recovery, and while it is not beyond the range of possibilities that a vicious person may be thus reformed, not only by physicians, but by others who give it their attention, it appears to be **incredulous** that a doctor should be able to give medicine, or hypnotic treatment, which is but a remedy, if not a drug, and in doing so should arrange that, whatever the result, no bad effects should attend upon its administration.

There is still another peculiarity about the method which, if true, may **lead** to its **abuse** in the hands of unprincipled operators. We refer to the fact that any one can so direct his patient that no other operator can have the least influence over him in the way of producing

hypnotism,—a fact which has been demonstrated by the admission of patients while under treatment.

To place an estimate upon the method here outlined without some practical exhibition of the power would be in the nature of attempting an impossibility; but there are two things which demand consideration because of the power which it is said one person thus gains over another. The first is, that no one should be subjected to the operation without having given full consent, or, if a minor, the consent of parents or guardians ought to be obtained. The second matter for consideration is, that no directions or suggestions of any character whatever should be given to the patient other than those bearing directly upon the disease. In the absence of these precautions, the plan may be made to serve those who would conduct their business with mercenary motives, and undoubtedly would lead to serious complications in our modern civilization.

EARTH DRESSING.

Earth dressing in surgery was first brought to the attention of the medical profession in this country through the investigations and writings of the late Dr. Addinell Hewson, of this city, about twenty years ago, and, while these applications have now been almost wholly superseded as topical remedies by recent antiseptic measures, there are certain directions in which the dressing may be employed to great advantage. The use of local applications of the kind are not, however, entirely discarded by the most active surgeons who are fully cognizant of the value of antiseptic precautions; the use in Germany and some other countries of common peat is much on the same principle as we use clay in this country, and, while there may be reasons at one time for a particular dressing, there may at another time be a demand for something else.

In the earlier history of the use of clay, it was far more popular than can ever be expected again, as the microbiotic mania had not then attained such wide-spread prevalence; then again, there was an objection to the use of a dressing which could cause so much inconvenience to the patient, and this difficulty was not readily overcome. Often the use of clay might be substituted for a poultice, but when the application is to be removed the clay dressing is decidedly objectionable. The result is that frequently the affected tissues are treated to a poultice as a routine method, instead of a suitable clay dressing, by which sickness is unduly prolonged and the life of the patient endangered.

For the reasons mentioned regarding the effect which the advance

of antisepsis has had upon this method of treatment it would not be advisable to study in detail the numerous applications which Hewson made in a general surgical practice, and it will be sufficient for the scope of this article if we take a brief survey of the conditions to which it is now applicable. The cheapness of the product, and the convenience with which it can be applied and removed by any one, to say nothing of its anodyne properties, its value as a deodorant and antiseptic, all combine to make its use of **great service** to the general practitioner.

A considerable proportion of the chronic, rheumatic, and gouty affections which may be seen in persons of all ages are decidedly benefited by mud-baths, such as used in Pistyan, in Hungary, a resort which has gained a world-wide reputation. For the relief of the above diseases, and also the cure of bone diseases and metallic poisoning, this plan is highly recommended by Sir Spencer Wells and other well-known authorities. A feature of these baths is that not only the water but also the mud contains an appreciable amount of sulphuretted hydrogen.

Lukashevich has used white modelling clay in epididymitis with success, and Maïzel has adopted the same method for the treatment of mastitis, and reports a number of cases in which it was used with apparent satisfaction. This application is also said to be useful for overcoming the distress attending unusual fullness of the breast, and, being readily obtained, is well adapted for country practice.

A preparation called **infusorial earth** has recently been recommended by a contributor to one of the German journals as an antiseptic dressing, and it has been suggested that this may be combined with salicylic acid, salol, iodoform, or corrosive sublimate for dressing wounds, or it may be used in the pure state. This product is sterilized by being subjected to heat sufficient to cause it to glow, and, it is said, will absorb from five to seven times its weight in water.

Fullers' earth is a popular domestic remedy, and is used principally as a dusting powder in weeping eczema and in the intertrigo which often occurs in children.

Kaolin is a pearly-white powder used in the same class of cases as that just mentioned. It is a product obtained from the decomposition of feldspar and quartz. May be used as a pill excipient for nitrate of silver, permanganate of potassium, etc.

Wherever clay for the manufacture of bricks can be found, there also will be found the clay best adapted for the relief of **local affections** presently to be mentioned, and all that is required is that the patient shall proceed to the brick-yard and obtain a supply as wanted.

As a **topical application** for the reduction of swellings and inflammations, whether of acute or chronic character, few methods of treatment

will be found to surpass the use of clay. An illustrative case will serve to impress this more firmly upon the mind of the reader, and is herewith appended. Mrs. B. is a lady just sixty years of age, and for more than twenty years has suffered from a **leg-ulcer** situated anteriorly at the junction of the lower with the middle third of the tibia; when the surface is unbroken there is lameness, but every year the cicatrix is ruptured, and there is a discharge of more or less pus, and until within the past two years she has always, by the directions of her physician, poulticed the affected area, with the result of removing large quantities of very disagreeable and foul-smelling pus. In this instance, however, the poultices were discarded, and the earth dressing applied, fresh daily, and was kept up for a period of two weeks. During this time numerous pimples and some large vesicles appeared upon the leg, both anteriorly and posteriorly, and the neighbors had very little difficulty in making her believe that the limb was in great danger, owing to the actual development of erysipelas. In a short time, however, the whole aspect of the ulcer changed for the better, and the clay applications were discontinued for the time, to be again renewed at the end of a fortnight, although during this second application there was no one to object to the treatment because the general improved appearance enforced silence. It will be sufficient to say that the ulcer healed and has remained well, the leg feeling strong, and, besides, the cicatrix does not adhere to the bone, so that for twenty years past her condition has not been so favorable as at present.

There is a general belief that cases of this kind should not be healed, from the fact that when the sore has acted vicariously in carrying off diseased products from the system any interference with this condition is liable to be followed by untoward symptoms in some other part of the economy. While this assumption may be true in some, probably in many cases, it is not applicable to all; and it should be added that suitable measures must be adopted with a view to favor the **functions** of **excretion**, thereby anticipating any trouble of this character, and that matter was duly attended to by the constant administration of the preparation known as calcium sulphide, a more complete reference to which will enable the student to estimate its value in this class of cases.

The method of **treatment** here outlined is eminently **successful** in the case of boils, carbuncles, and in felon (paronychia). When a **boil** or **carbuncle** has been treated in the usual manner for several days, and has become very tender, it may be required that some local application of a sedative character should first be used, and it may be so tender that the clay treatment cannot be adopted; but if taken in the **early stages** the results of treatment will be far superior to the so-called antiphlogistic

method, which consists in thoroughly dividing the tissues, then using emollient applications and opiates to relieve pain. Few are willing to have active operations of this kind attempted, and will suffer for months great torture, until by means of poultices the tissues have been rotted and spontaneous evacuation takes place. This is **all wrong**; in the treatment of these cases and also that of **felon**, the free use of the clay will answer as a support to the inflamed tissues, while reducing the active circulation, and for the time being will assuage the pain, as it can be kept moist by repeated applications of cold water. **Systemic** remedies may be used temporarily to control the circulation, and the patient should be restricted in the use of the affected hand in felon, but the continuous use of the **calcium sulphide** must not be omitted. By its use we prevent the formation of pus, and where pus is present the drug has the effect of liquefying it promptly, when all that is necessary for the surgeon to do is to provide a means of exit by a simple puncture. The escape of laudable pus is followed by the filling up of the cavity with healthy granulations, and in an incredibly short time all traces of the affection will be removed.

Many of these cases will come under the observation of the physician after great damage has been effected by the indiscriminate use of poultices, and in order to obtain a healthy condition of the tissues with a sufficient quantity of blood to make the necessary repairs clay dressing is demanded. No improvement can be expected when the tissues present a white, soggy, and lifeless appearance, and the best way to secure the desired object is by the judicious use of the clay. Whatever **antiseptic measures** may be indicated afterward, this preliminary treatment will not affect, and it will be found that healing will go on promptly and all unfavorable symptoms rapidly disappear.

In selecting a **suitable clay**, it is only necessary that it should be free from septic influences and all gritty substances, and, when properly prepared and applied, it will not cause the least untoward symptom to the most delicate skin.

BAUNSCHEIDTISMUS.

The popularity which attended the first announcement of the treatment of various diseases by the use of the instrument invented by Charles Baunscheidt is of sufficient importance to attract the attention of the modern investigator who wishes to take advantage of all those measures which are calculated to advance the interests of the medical profession. Baunscheidt gave his discovery to the world in the form of a small

brochure in the year 1851, and within a short time no less than six editions had been called for, and translations followed into English and other languages. Thousands of people from all parts of the world visited him for the purpose of having him apply the "Lebenswecker" (life-reviver), although it was well known that he did not claim to be a qualified physician, and, while all of the cases were not successful, enough of them recovered to form a strong popular current in his favor and against the common practice of using drugs for the relief of disease.

The **method** is simply a peculiar form of **counter-irritation**, which will be better understood when it is related that the discovery resulted from the inventor allowing a number of gnats to sting one of his hands, which was at the time suffering from ulceration and swelling connected with gout. The disappearance of the pain suggested the idea of making punctures similar to those which had followed the work of these insects, when the tissues should be anointed with an oily substance as near as possible like that secreted by the gnats. It was believed then that the oil would penetrate the punctures and that the disease would thus be relieved, but of course we cannot accept any such notions at the present day. The prompt **disappearance of pain** from acupuncture—to be considered presently—in lumbago, and its instantaneous subsidence in the case of paronychia when a needle or sharp-pointed knife is thrust deeply into the affected tissues, demonstrates that the oil has nothing of much consequence to do with the relief which follows. This is practically true of the Lebenswecker, although, as a rule, it has been found more efficient in many cases when some slight counter-irritant was added by applying with a brush over the spots which have been left by the instrument.

It may be noted here that one Dr. Terc, of England, has lately recommended the sting of bees for rheumatism, and claims to have treated successfully one hundred and seventy-three cases, administering in all no less than thirty-nine thousand stings.

As at present **constructed**, the instrument is composed of a small disk, which contains probably twenty-five needles, so connected with a coiled spring that when it is compressed and then loosened the recoil causes the needles to penetrate the tissues to the depth of five-sixteenths of an inch. Only a small quantity of blood oozes through the skin after one of these applications, and almost any number can be made at a sitting, but **care** must be **taken** to avoid bony prominences and large blood-vessels, from the fact that ecchymosis, or even active hæmorrhage, might follow. There are a large number of both acute and chronic maladies which yield readily to these applications, and the promptness with which some of the most obstinate cases are subdued is at times marvellous, but, in order to be successful, judgment must be exercised in their selection.

THERAPY.—In the selection of **suitable cases** for the study of Baunscheidtismus, we must bear in mind that it can have no possible influence over organic affections, nor upon diseases which are dependent upon a lowered vitality connected with or due to chronic organic disease. It can only act as a revitalizer through its influence as a revulsive and counter-irritant except through its effect upon the mind,—a matter of no small consideration. The effects of a **rheumatic element** in the system are often more promptly relieved (which may include sciatica, lumbago, and neuralgia) by this than by any other application, not excepting the actual cautery. The number of so-called "spots" that are made at one time, and the frequency of the applications, will, of course, have to be determined by the physician, and it does not seem warranted that we must discontinue all other treatment. **Glandular swellings** are often remarkably affected by this treatment. The same applies to the treatment of simple toothache and earache, a single application being sufficient to silence the pain for the time.

Occasionally there will be found a **depressed condition** of the whole system, in which the skin and underlying tissues seem to partake, where medicines are ineffectual, and where electricity and clay-baths are not at hand, when "spots" to the number of several hundred can be made over the surface of the body, not only without danger, but with the very best results.

Baunscheidtismus may be used for the removal of tattoo-marks by Variot's method, which consists in first painting the part with a strong solution of tannin, then pricking the skin to permit the tannin to penetrate. This latter operation may be performed by means of the instrument under consideration. To complete the treatment the area is then slightly cauterized with silver nitrate, the punctures turning black, when the surface is cleansed. The inflammation subsides in from ten days to two weeks, and leaves no indications of an operation having been performed.

Great care is necessary in the use of such an instrument to avoid **septic** and **contagious** influences, but, with our present antiseptic appliances, no one would think for a moment of omitting measures of this kind. As an **external application**, any irritant oil may be used in small quantity with a camel-hair pencil. Either cajuput-oil or a solution of one to four of croton-oil answers the purpose admirably.

Acupuncture may be called a modified form of the treatment which has just been described. It consists in the **use of needles** with hard rubber, wax, or metal heads, which are introduced several inches into the affected tissues. The great depth to which they are inserted makes their use much more formidable than that of the instrument previously described, but by adopting a slight rotary movement their introduction

may be accomplished with but little pain. One or more may be used, and in the cases just mentioned the relief which is afforded is often surprising.

Aquapuncture is a method of counter-irritation, having for its object the **introduction** of a quantity of **water** into the cellular tissues or into the muscular substance. It may be conducted with an ordinary hypodermatic syringe, or a special instrument which permits of the introduction of water at several points may be used. In the use of water the suggestion is made that the contents of the syringe be deposited in the immediate vicinity of the affected nerve, and the effect should be watched that the pain, on disappearing at one point, may promptly reappear in the same form at another not far distant, in which case the **injection** will have to be **repeated.**

From what has been said of Baunscheidtismus, of acupuncture, and of aquapuncture, it will be evident that much of the benefit derived from these applications results from the **revulsive effect** which attends upon the introduction of the needles or needle, but we are scarcely willing to admit here that only so much good results from the hypodermatic injection of morphine and other alkaloids which have for their object the relief of pain. There are times when the proper use of the hypodermatic needle without water or medication will answer the purpose as well as if it contained the most powerful medicine that could safely be used. This statement will apply to many cases of neuralgia affecting superficial nerves, and to cases of sciatica which have not become chronic; but too much confidence should not be placed upon simple measures of this kind unless the cases are properly selected, as they are not always successful.

CLIMATOLOGY.

The word **climate** is used to designate the exceedingly **complex influence** of varying conditions of the atmosphere as regards temperature, moisture, purity of composition, and electrical tension. **Currents** of movement prevail more or less constantly, by which the temperature and moisture of the air are markedly affected. Climatic states are also closely dependent upon the **physical configuration** of the earth's surface, the nature of the **surface** and **soil**, the presence of large bodies of **water**, the variety and abundance of **vegetation**, length of the **day**, and, no doubt, upon many other less known but powerful agencies.

At the **equator** the rays of the sun fall vertically upon the earth's surface and its aërial envelope, and upon this line, therefore, we meet with **maximum temperatures**, since the more oblique the angle which the

sunbeam forms with the surface, the greater is the area submitted to its influence, and the less is the quantity of heat actually received. If, then, the surface of the earth were plane, and if the atmosphere were motionless, the temperature at a given latitude might be determined by mathematical calculation.

Temperature, however, steadily **declines** with the **elevation** above the sea level. The **rate** of this diminution is quite variable, but has been estimated at one degree Fahrenheit for every three hundred feet of perpendicular ascent. Upon lofty mountains a line is reached at which the moisture of the air is permanently frozen, and the lowest point at which this congelation occurs is termed the **snow-line,** or line of perpetual snow. The height of the snow-line is greatest at the equator, but is a **variable** point even upon the same parallel. Its **position** is not **determined** solely by altitude, but is governed, to some extent, by other circumstances, such as habitual dryness or moisture of the atmosphere, form of the mountain, etc. The sun's rays strike upon the earth much more obliquely in winter than in summer at latitudes distant from the equator.

Temperature is likewise **modified** by **winds.** Currents of motion are excited in the atmosphere by the **expansion** of portions of air in contact with the heated surface of the earth. The heated air is borne upward to higher strata, while its place is taken by colder air which rushes in from above. Thus the temperature of the earth's crust, of the atmosphere, and of the aërial currents act and react upon each other. The **direction** in which winds blow depends upon the distribution of heat upon the surface of the globe,—the rarefaction and displacement of the heated air and the rotation of the earth upon its axis. It has been shown by Buchan,* that **prevailing winds** are due to difference of atmospheric pressure, and that they flow from a region of high to one of low pressure.

Air always contains some **aqueous vapor.** When capable of holding no more it is said to have reached its point of **saturation.** The higher the temperature of the air, the more moisture it is capable of absorbing. This capacity is doubled for every twenty-seven degrees Fahrenheit of temperature above the freezing-point, the temperature increasing in an arithmetical and its absorbent power for moisture in a geometrical ratio. The quantity of water in a given volume of air is called the **absolute humidity.** The degree of dampness is termed **relative humidity,** and represents the mutual influence of absolute humidity and temperature. Over large bodies of water, as the ocean and great lakes of North America, the atmosphere is constantly charged with a large quantity of moisture; hence **ocean winds** are laden with moisture. If they

* "On the Mean Pressure of the Atmosphere and the Prevailing Winds over the Globe." Trans. Roy. So. Edinb., 1868.

blow from the north they are cold; if from the south they are warm. The converse of this proposition is true of Southern latitudes. Winds which traverse **sandy plains** part with moisture and become hot and dry.

On account of its different absorbent capacity for moisture at different temperatures, if a warm atmospheric current be rapidly chilled the excess of moisture is precipitated as **rain** or **snow.** This is what happens when a warm ocean wind comes in contact with the cooler atmosphere of a mountain side. If the course of the **mountain range** of a country be perpendicular to that of its prevailing wind, the moisture is lost from the latter and the climate upon the opposite side is dry; but if the direction of the mountain chain and prevailing wind be parallel, or nearly so, the climatic difference between the two sides is not marked.

The **atmosphere** exerts, at the level of the sea, a **pressure** of fifteen pounds upon each square inch, but as we rise above this elevation the pressure diminishes at the rate of one pound for every two thousand feet. It may be surmised, therefore, that the **elevation** of a country above the sea has an **important infiuence** upon organic life.

The nature of the **surface** and **soil** has a notable effect upon the temperature, moisture, and purity of the air. **Sand** is a poor conductor, as heat accumulates at the surface and is radiated. During the night it parts with much heat; the climate of sandy deserts is, therefore, hot by day and distinctly cold by night. **Loam** and **clay** are better conductors, heat falling upon their surfaces being quickly conveyed downward; consequently, these soils are neither so hot by day nor cool by night.

Ground covered by **vegetation** does not become heated to the same degree as that which is bare; there is, consequently, a more **equable distribution** of heat throughout the twenty-four hours. Forests protect the earth from the influence of the sun; they also diminish evaporation and increase humidity.

It has been stated that large bodies of water communicate an abundance of moisture to the atmosphere; they also affect climate through the absorption of heat. **Water** is remarkable for its great specific heat; it absorbs atmospheric heat slowly, and parts with it similarly by radiation, and thus acts as a **conservator of temperature,** moderating the heat of summer and the cold of winter. Warm **ocean currents,** particularly the Gulf-stream, which flows like a river through the ocean, produce a considerable effect upon the climate, not only of the ocean itself, but also that of the coasts which it approaches. The comparatively **moderate climate** of the British Islands is, in part, due to this cause. The same effect is produced by the Japan-stream upon the climate of our Pacific coast. To acquire the benefit of an **ocean climate** one must

take a sea-voyage, but residence upon a small island situated at some distance from the main land approximates the same conditions, provided the locality is favorable.

The climate of different regions differs in respect to the amount of **free electricity** present in the atmosphere. The electricity of the air is of a **positive** quality, while that of the earth is **negative.** The origin of the former is, therefore, supposed to be by induction from the latter. Free electricity is **most abundant** in cold, dry climates, and at a high altitude. In situations where the air is but little exposed to contamination, as at sea or upon mountain sides, a portion of the oxygen is thought to exist under the form of **ozone.**

An exact **estimate** of the **effect of climate** upon the health of man is very difficult and perhaps not even possible; for, not the least important feature of a climate is its favorable or unfavorable influence upon **habits** conducive to health and strength. On the other hand, human races are found subsisting in **every variety** of climate. The shores of the Arctic Ocean; the damp forests of South America; the hot, low coast of Guinea; the jungles of India, and the frozen plains of Siberia and British America are found peopled by indigenous tribes, each of which seems to flourish in its native habitat. As a rule, mountaineers and Northern men are larger and possessed of more vigor and endurance than lowlanders and Southern races. Climates which prove extremely deadly to white men seem comparatively innocuous to the native races, who seemingly inherit an adaptation to their atmospheric and physical environment; although, possibly, we have heretofore overestimated the immunity enjoyed by natives. The **paludal fevers** which prevail in Cochin China during the rainy season spare neither natives nor strangers. In Senegal, though fewer blacks than whites are admitted to hospital, yet the former remain five times as long as the latter, and the **mortality** is somewhat higher.

Again, in attempting to determine the influence of climate, it is doubtful how far we are justified in ascribing the grave, specific **diseases of the tropics** to climate *per se.* The **drainage** of marshes is capable of abolishing malarial fevers, and preventive medicine is not without hope that disorders hitherto considered as peculiarly of climatic origin may eventually yield to prophylactic measures based upon scientific researches. By modifications of the earth's surface man has undoubtedly been instrumental in affecting marked climatic alterations; and it is not improbable that, stimulated by colonizing or commercial enterprise, he may yet succeed in rendering habitable to civilized races tracts of country in which they have as yet been unable to dwell.

The fact, however, that a **constitutional adaptation** to climate does occur and may be either inborn or acquired is shown by the observation that a

change of climate is attended by a period during which the system is uneasily accommodating itself to its changed surroundings. During this time the resistant powers are diminished, as Americans or Europeans fall an easy prey to tropical fevers. Even a less-marked contrast, as from the Atlantic to the Pacific seaboard, the Rocky Mountains, the prairies of the Northwest, or to the Gulf coast, gives rise to certain perturbations of health. This gradual habituation to unaccustomed climatic influences is termed **acclimatization.**

Accurate comparative observations upon the effect of climate are especially desired. Dr. Rattray, of the British Navy,* has demonstrated that, contrary to the opinion usually entertained, the **rate of respiration** diminishes in persons passing from a temperate to a hot climate. The variation was not always the same; in some cases the rate fell from 16.5 in England, in winter, to 12.74 and 13.74 in the tropics. A consequence of this was a **notable reduction** in the quantity of air respired. The **average** in the temperate zone at 54° F. is 239.91 cubic inches per minute, while in the tropics at 82° F. only 195.69 cubic inches were inspired,—a difference of 38.65 cubic feet in twenty-four hours. Rattray also found that the **heart's action** was slower in the tropics, and that the average pulse-rate was $2\frac{1}{2}$ beats per minute less than in temperate climates. The same observer estimated that in hot countries the functional activity of the **skin** is increased by 24 per cent. The **appetite** is diminished, the taste for animal food is impaired; that for cool fruit is increased. The quantity of **bile** is not increased, judging by the amount passed with the fæces.

The effect of **moist heat** is especially depressant. In Tonquin bodily or mental effort is almost impossible to Europeans in summer, as may be seen from the following conditions: **Drowsiness** is unintermitting, the skin is constantly covered with **perspiration,** and, spite of drowsiness, sound sleep can only be obtained after repeated cold baths. During the hottest period there is a difference of only 3°–4° C. (5.4° to 7.2° F.) between day and night, and the humidity adds to the suffering produced by the high temperature. At the same time it has been noticed that the anæmia and depression due to summer heat leaves the **system** remarkably **susceptible** to the impression of cold. After a year's residence, however, a temperature of 12° C. (53.6° F.) can scarcely be borne without fire.†

Experience convinces us that, whether we are able or not to give a rational explanation of the fact, improvement takes place in an invalid's condition simply by a change from one climate to another—exchange of climate. We should endeavor to be judicious in influencing the **choice**

* "On the Effects of Change of Climate on the Human Economy," by A. Rattray, M.D., Surgeon R. N., in Proceedings of the Royal Society, Nos. 122-126, 139 (1869-72).

† Annual of the Universal Medical Sciences, 1888: "Medical Climatology and Balneology," by George H. Rohé, of Baltimore, Md.

of climate. It is probable that certain atmospheric and telluric conditions are peculiarly beneficial in certain diseases. We receive less aid than might be expected from a study of prevalent diseases. Those characteristic of hot countries are, for the most part, of infectious origin, and therefore largely preventable; and in temperate climates we find phthisis develop in the natives of the very regions to which consumptives are sent as health resorts, *e.g.*, Switzerland and Minnesota.

The United States furnishes us with a great number of **health resorts** of every variety of climate. Our extensive coast, chain of great lakes, and immense river system enable us to take advantage of an ocean climate or of the pure air found over large bodies of water. The **purest air is** found at sea, on mountains, on elevated table-lands, and in **pine-forests.** These are, therefore, the localities which suggest themselves when change of climate becomes desirable. But a **change of climate** involves, or should involve, much more than altered atmospheric conditions. Change of scene, of interests, of occupation, and of habits result from change of place, and each of these factors has its effect in promoting improvement. Increased activity out-of-doors is a very important essential of the new mode of life. To secure the **advantage of change** the invalid must freely expose himself to the influence of the climate.

A **temporary** change is of undoubted benefit after a severe attack of acute illness. The nature of the **disease** and the **season** of the year are circumstances which should govern our choice of a place to be visited; but chronic disorders demand **permanent** or, at least, long-continued residence. **Pulmonary tuberculosis** is the affection, above all others, to which the climate cure is applicable. Whenever possible, the patient should be sent away as soon as the disease has manifested itself. Nothing is more pitiable than to see one far advanced in the second stage compelled to take a long and tiresome journey, to leave home and friends and go among strangers, to arrive exhausted at his destination only to die far away from home. In the first stage, however, phthisis is susceptible of **remarkable improvement** from suitable climate, aided by out-of-door life and exercise. The progress of infection is delayed or checked, the bacilli perish or become inactive, the products of inflammation are absorbed, the symptoms are ameliorated, cough lessens or disappears, appetite and digestion improve, the sleep becomes sound and refreshing, and the strength and weight are increased. These results, it is true, cannot always be expected, yet they occur in a **considerable proportion** of cases. But it cannot be asserted that any variety of climate is of **specific efficacy** in consumption. **Some** cases will do better at sea; **others** in the mountains or woods, upon high plains or upon a Southern sea-coast. Nor is it possible to decide infallibly in a given case which

resort will be found most beneficial. The previous condition and habits of the patient may assist us in forming a conclusion. If a man has been tolerably robust and active, invigorated by cold weather, a cold, dry climate, such as that of **Minnesota**, will probably be found of advantage. It is prudent not to make the change to a cold climate in winter. **Colorado** is also beneficial in cases of the same type. On account of its elevation and diminished atmospheric pressure, Colorado should not be recommended where a disposition to **hæmoptysis** is present, where the heart is weak or diseased, or where an active pneumonia or emphysema is present. If the patient is of delicate build, averse to cold weather and physical exercise, a mild climate, either moist or dry, is preferable. The Adirondacks in summer; Thomasville, Ga.; Asheville, N. C.; Aiken, Ga.; Florida, and the Gulf coast in winter; and Southern California at all seasons, offer a wide selection, by which other considerations than that of health may be met. The emanations from **pine-forests** are held by some to possess direct antiseptic properties. We are not able, however, to place much reliance upon this consideration. As a rule, men are more likely than women to be benefited by a cold climate. Also, a dry is more generally advantageous than a moist atmosphere, as a rule, although not infrequently a moderately-warm moist air is decidedly beneficial to cough. An **ocean voyage** in warm latitudes is one of the best modes of climatic treatment. Patients seldom fail in obtaining relief, and hæmoptysis has proved no contra-indication.

As **scrofula** is generated or, at least, nourished by unsanatory modes of life, it is susceptible of improvement by climatic influences. A warm and dry air, with out-of-door life, is that to which we should recommend such patients to resort. **Syphilis** may also be benefited by the same conditions.

Catarrhal affections of the respiratory passages are often markedly benefited by changed atmospheric surroundings, although we may not always predict the locality which will be found most suitable. Some cases are relieved by moisture, others by dryness. These troubles are apt to become worse in cold climates. **Asthma** is not seldom ameliorated by a total change,—from moist to dry or *vice versâ*, from low to high, or from coast to inland region.

Diabetes mellitus requires warmth. The temperature is depressed in this disease. The patient does better in a warm, uniform climate. This serves the further purpose of promoting the action of the skin,—always an important requisite in the treatment. The same is true of **diabetes insipidus.**

Chronic rheumatism, muscular rheumatism, and rheumatoid arthritis often derive more alleviation from a change to a warm, dry climate than

from any remedy or combination of remedies that can be devised. The indication to leave a malarious district seems plain. Chronic forms of **malarial poisoning** not only linger indefinitely, but they also predispose to secondary ailments dependent upon impaired nutrition. The patient should be transferred to a high, cool, dry region, destitute of swamps. **Mountain air** exerts a very favorable influence upon **anæmia,** whether dependent upon simple loss of blood (hæmorrhage), malaria, digestive failure, or even lead and mercury poisoning.*

The more inveterate forms of **skin disease** are often more signally relieved by climatic change than by medicaments, however seemingly appropriate.

The skin should be maintained in healthy activity in cases of **morbus Brightii.** This suggests removal to a mild, equable climate, or, at any rate, an avoidance of Northern winters. Excessive cold casts an undue burden upon the kidneys, and, we think, begets a predisposition to the disease.

The **liver** is best able to perform its important functions in moderately cool and elevated regions. These are therefore the places which should be sought by those in whom structural disease of the liver has been induced by residence in hot climates. **Malaria** is also a cause of organic liver trouble, so that climates found beneficial to the former prove of advantage also to the latter affection.

LIGHT.

The sun's rays supply us with both **light and heat,** and each natural force has an important influence upon the manifestation of vegetable and animal life. Their source being the same, their **effects** also are closely **conjoined** so that it becomes a work of difficulty, if not an impossibility, to discriminate between those due singly to heat or to light. The **health** of higher organisms soon **fails** when totally deprived of the stimulus of light. This is **exemplified** by the almost complete absence of life in large subterranean caverns. The scanty fauna of the Mammoth Cave, in Kentucky, principally consists of articulated animals, but four vertebrated species being found. These present marked peculiarities of development, and are small, stunted creatures. Through the cave of Adelsberg, in Carniola, flows a stream inhabited by a batrachian species found nowhere else, the *Proteus anguinus.* It has an eel-like body, with four small, weak legs, is provided with both gills and lungs; and exhibits an aversion to light; its body is white, but gradually grows dark upon exposure to the light; the

* Dr. E. A. Parkes: "A Manual of Practical Hygiene." New York, 1884.

eyes are very small and covered by skin. The Cavern del Guacharo, in the district of Caracas, Venezuela, was explored and described by Alexander von Humboldt. Its entrance, eighty feet broad and seventy-two feet high, is remarkable for the display of tropical vegetation. Tall trees spring from its vault, while festoons of climbing plants drape the mouth. Large plants flourish within the cave until the daylight is lost. The name is obtained from the nocturnal frugivorous bird which haunts the cave. Seeds let fall by these birds far within its dark recesses germinate in the mold deposited by the stream which occupies the fissure. Striking is the contrast between this growth, deprived of sunlight, and the luxuriant verdure at the mouth.

Pale stalks a few feet in height and half-formed leaves strongly attest the necessity of light to vigorous vegetable life. The green coloring matter (**chlorophyl**) of plants, so essential to their nutritive processes, is formed only in the presence of light.

Dr. Kane testifies to the extremely depressant effect of the long **Arctic night**, and speaks of **darkness** as "the worst enemy we have to face." The effect was more severe **upon dogs,** though born within the frigid zone, they being destitute of intellectual resources and artificial light. He states that "most of them died from an anomalous form of disease to which, I am satisfied, the absence of light contributed as much as the extreme cold." Epileptiform convulsions were succeeded by perverted intellection, and the animals frequently perished with tetanoid manifestations.

The **pallor** of unhealthy, ill-developed, rachitic or scrofulous children reared in the narrow, reeking alleys and courts of **populous cities** is partially due to the comparative deprivation of sunlight. Weavers, shoemakers, and those who pursue other **sedentary trades** are apt to be of inferior physique. Their defective vigor may, with reason, be partly attributed to insufficient exposure to the sun.

The inspiriting effect of fine, bright weather is proverbial, and is in marked contrast with the depression of spirits caused by sunless days. Cases of illness do better in clear than in cloudy weather. The presence of light exerts a stimulant effect upon the **cerebral centres**, conducive not only to their own healthy action, but also to that of lower centres over which they preside.

It has been shown that **solar light** is possessed of chemical power, which seems to reside in the **violet rays** or in those between the violet and blue. The formation of chlorophyl, the decomposition of carbonic acid, and the quality of vegetable juices depend upon the **chemical properties** of light. It is equally certain that the **nutritive functions** of animal life are profoundly influenced by the presence or absence of light. Darkness

begets anæmia and the long train of ills involving the glandular, muscular, and nervous systems which follow impoverishment of the blood.

THERAPY.—The benefits of sunlight are, therefore, called for whenever the processes of **sanguification** are at fault. Undoubtedly, a portion of the good results of suitable outdoor exercise are assignable to the influence of light. Patients who suffer from severe, chronic **dyspepsia** should walk, ride or sit in the sun every day. The same remark applies to the victims of **anæmia. Chlorosis,** too, is an affection which compels us to take advantage of every hygienic measure possible. Both digestion and absorption are stimulated by the sun's rays. The solarium is serviceable as a vehicle of light as well as of heat. **Neuralgia** dependent upon the quality of the blood demands the influence of light. **Hysteria** is favorably modified by light and the multiform healthful influences found only in the train of light. Cheerful surroundings are of immense importance to the **melancholic.** The various forms of **neurasthenia** are susceptible of improvement by the same method. To the valetudinarian or the convalescent a gentle walk in bright weather is attended by a stream of tonic agencies arising from the sense of sight and from the direct influence of sunlight upon the surface of the body. It is **a mistake,** during the progress of a continued fever, to exclude light from the sick-room, unless in exceptional instances. The nervous phenomena are favorably affected by the admission of light; delirium is lessened and sleep promoted by marking the distinction between day and night.

In conclusion, the **tendency of sunlight** is to beget appetite, promote digestion and absorption, and assist in the healthy elaboration of blood and its continuous depuration by secretive and excretive selection.

MUSIC.

Such is the exquisite adaptation of Nature that the exercise, within their prescribed limits, of the functions of **special sense** constitutes a source of **pleasure.** We become so habituated to the grateful influence of light that we often fail to realize its vivifying power. Beautiful or grand scenery, pictures, statuary, or architecture, nevertheless, silently impart their benefits. The **sense of hearing** is the avenue by which the system is swayed by the powerful agency of music.

Music results from the artistic combination of tones. The range of possible combinations is infinite or, practically, exhaustless. As, normally, all are endowed with the sense of hearing, the succession and combination of sounds have not entirely escaped the attention of the wildest races. **Taste,** however, is the result of education and trans-

mitted tendencies. The simple and often **harsh melody** of savages is seldom pleasing to the cultivated ears of civilized peoples, and often merits the epithet of mere discord or noise.

Most rude tribes possess **characteristic strains** which they have probably slowly elaborated, and which may be considered as the highest expression of their taste and talent in music. These melodies are appropriated to the celebration of those themes which have ever possessed most interest to mankind in every state,—religion, war, triumph, and love. The higher the race and the more skilled in the art, the more capable it becomes of inspiration by its national airs. Music affects every portion of the system by acting primarily upon the higher cerebral centres,—those of hearing, of the emotions, and of thought. It affects the memory, the imagination, and even the will. The entire working of the organism, mental and physical, may therefore be influenced by this noble art.

The Greeks well fabled that music was of divine origin. Its **association,** in all countries and ages, with the ceremonies of worship illustrates the pure and lofty nature of the conceptions with which it has ever been regarded. More indefinite or general than speech,—poetry, for instance, or even song; at least, as regards the words of the song,—music is nevertheless more powerful than articulate language. The great efforts of musical genius seem like works of inspiration.

An **apt example** of the effect of music upon the organism is afforded by contrasting the emotions excited by a martial air and a funeral dirge. Different, again, are those called forth by the noble productions of sacred music. National airs, popular melodies, and musical instruments are intimately bound up with thoughts of home, hope, and youth,—the purest feelings of which our natures are capable. Under appropriate circumstances, they are able to evoke all the power, patriotism, and nobility that are in human nature. The **bagpipe** is generally regarded as a dissonant instrument, yet no instrument or melody in the world could equal its effects upon the Highland troops as they marched under Havelock to the relief of Lucknow. **Martial music** calls up thoughts of devoted heroism; it enables men to face the deadly hail of battle as if going to a dance. **A waltz** causes the maiden's heart to beat, her eye to sparkle, her cheek to flush, and her foot to beat time. Music is peculiarly associated with scenes of gayety and happiness. Representations which combine the effects of the chief musical instruments with human voices in chorus, concerted and solo parts, the most colossal works of art, are eminently fitted to send a thrill of magnanimity through the entire organism. From the higher centres its effects are transmitted by means of the sympathetic nerve. Its stimulus thus

applies to all the great organs of the economy. **Mental life** is raised into a higher sphere of consciousness; the heart, the lungs, the chylopoëtic viscera, and the spinal cord are all improved as regards their nutrition.

THERAPY.—The stimulus of music renders it a valuable and delightful resource in **depression of spirits,** whether due merely to strain of body or mind, or to actual melancholia. A noteworthy example of the influence of harmony in the last-named condition lately came within personal experience. Having charge of a gentleman so afflicted, the capitals of Europe were visited in search of every advantage of travel and recreation, but nothing touched the settled gloom of the patient until, in Vienna, we resorted to the **grand opera.** While listening mechanically to dulcet symphonies intertwined with the mellifluous notes of enrapturing *cadenzas*, following each other in rapid succession and harmonic progression, there appeared in the patient's face and demeanor the first manifestation of interest that had been noticeable for months. Subsequent visits not only confirmed the opinion first entertained, but continued and augmented the impression thus produced, until within a few weeks we had the satisfaction of witnessing a complete recovery.

The distressing tension of the nervous system and the restlessness engendered by business cares and rivalries, or continued suspense, which are often productive of **insomnia,** are sensibly modified and soothed by music. The chronic **dyspeptic** is very apt to be sad, morose, irritable, or hypochondriacal; such should be encouraged to resort to the concert and the opera for entertainment and improvement. Those who have become weary from continued pursuit of an engrossing intellectual occupation may be most happily refreshed through the instrumentality of music. In short, this beautiful art is a most **valuable restorative** to physical or mental energies enfeebled by too assiduous employment.

BLOOD-LETTING.

While the practice of blood-letting is not wholly confined to surgery, it is more distinctly connected with the practice of medicine than with therapeutics. It is, however, a remedial agent which the practitioner may be called upon to adopt, and in some respects is **complementary** to the **practice of transfusion**; and, although the scope of the present work does not permit its consideration in detail, the authors feel warranted in directing attention to the conditions which seem to demand it, together

with some remarks regarding the advantages to be gained therefrom, as well as the dangers to be avoided.

The **methods employed** for this purpose are various, but ordinarily they may be divided into general and local blood-letting. In the former is included venesection, arteriotomy, and cardiocentesis, or cardiac puncture; while in the latter may be mentioned cupping, puncturing, scarification, incision, and leeching,—all methods which have special indications, but which are so well known that but little attention need be given to them. The subject of **local blood-letting** will therefore be referred to briefly at the close of the present article.

General blood-letting is usually practiced by means of venesection, and the opinion as to its value has undergone many and material changes within the past century. At present there is a consensus of opinion that this practice, once so highly prized, should not be wholly relegated to oblivion, although it should be noted that there is still a **popular prejudice** against the custom, which has doubtless been fanned into activity by those who would make capital by their opposition to established usages. That venesection is a **valuable procedure** under certain conditions there can be no question in the minds of experienced physicians, but that the remedy may be abused by its adoption when uncalled for we shall not attempt to deny. Before pointing out the indications for its employment, therefore, it will be appropriate to give some attention to the conditions which it counteracts, together with some reference to the effects that may be secured.

Venesection may be employed either for its general or for its local action. In the case of a general plethoric condition of the system, accompanied by lassitude and mental hebetude, the withdrawal of blood from a vein will be followed by an improvement which will manifest itself throughout the entire system. Having admitted this much, we are prepared to understand and appreciate the advantages that might accrue in similar cases characterized by general turgescence of the blood-vascular system, in which the more highly organized structures, like the **cerebral tissues,** stand in imminent danger of being injured should the congestion continue. Again, reasoning from analogy, we are warranted in assuming that, as the whole of a thing is greater than any of its parts, **special organs** or parts of the human system may receive proportionate good from the same influence which benefits the entire organism. Thus, **acute congestions** affecting the liver, the kidneys, the lungs, or that resulting from contusions and other injuries, may be relieved in part, if not wholly overcome, by the timely withdrawal of an amount of the circulating fluid which shall perceptibly modify the activity of the circulation. This proposition is true, however, only so far as it applies to those organs and

tissues which are within the range of the general circulation, and would not apply with equal force to parts that are in some respects isolated, such, for instance, as the extremities, or to congestions affecting the organs of vision. Here it would be requisite, to obtain local effects, that local blood-letting should be practiced, and experience is fully in accord with these conclusions.

In this connection it will be useful to note that the principles just outlined are more especially applicable to what are known as **sthenic cases**, in which acute congestions may be relieved without seriously embarrassing the vitality of the patient. The force and frequency of the pulse are lessened, and an artificial anæmia is thus created, which, in the asthenic, might result disastrously to the patient. The **convulsions** which are liable to follow in these cases are supposed to be due, in part, to a want of oxygen when the progress of active inflammation begins to subside, although we must not forget that the accumulation of carbonic acid in the system has the effect of partly subduing the pain. After free venesection has been practiced there is a notable impairment of all the functions except that of **absorption,** which is largely augmented, although this depression is but temporary; and it is under these conditions that we are able to observe the marked benefits which attend upon the exhibition of certain remedies,—for example, stimulants.

The relation which **venesection** bears to **transfusion** will be apparent from a study of the uses which may be made of these two methods in the case of **poisoning.** By the first we are enabled to rid the economy at once of a considerable portion of a poison which affects the nervous system through its presence in the blood, and thus the alternate use of venesection and transfusion will at times enable the physician to carry his patient over a critical period which could not be fully met by the administration of physiological antagonists.

Substitutes have been offered for general blood-letting in the treatment of the initial period of various affections, notably that of pneumonia, and, without trenching upon the contagious character of this disease, some of them may be referred to as follows: **Ergot** has been strongly recommended because of its property of contracting the smaller blood-vessels, and thus preventing the congestion and engorgement of the capillaries of the delicate pulmonary tissue. Upon the same principle, **barium chloride** has been given, as well as **digitalis,** but it is doubtful if these remedies alone, in well-marked cases, can control and counteract the progress of the disease, because their successful use depends upon their power over the heart. Whenever the effect of the drug is such that the *vis a frontis* is sufficient to overcome the *vis a tergo*, then the activity of the circulation will subside; but so long as the powerful

contractions of the cardiac muscle are not modified there will be the danger that the delicate structures of the lung may give way. The theory is an excellent one, and may serve a good and sufficient purpose in a large number of cases, but it cannot altogether be relied upon. On the other hand, we have to note the use of **aconite, gelsemium,** and **veratrum** by some practitioners, these remedies being given in the expectation that the force of the heart will be so modified that resolution will take place through the influence of the *vis medicatrix naturæ*, and the general principles involved in this method, it must be confessed, appear to be more practical than those of the former. The danger on this side is that the remedy may be continued to an extent that the heart-muscle will be so affected that failure is threatened, and either plan, therefore, must be carried out with the greatest caution. Cold applications have also been used, as well as hot fomentations, but these have already been considered under their appropriate heading.

THERAPY.—The use of the lancet in all cases of **pulmonary congestion** was for many years an established custom, and Hartshorne, of Philadelphia, has very industriously collected a vast array of statistics going to show that the mortality in pneumonia has materially increased since the discontinuance of the practice. Due allowance, however, is to be made for all conclusions based upon statistics alone, for it is an acknowledged fact that such deductions are notoriously misleading. It cannot be gainsaid, however, that under the conditions just outlined the use of the lancet will be the means of affording marked benefit in the initial period of pneumonia, before consolidation has taken place. Although it may appear paradoxical, venesection is useful in cases of **pulmonary hæmorrhage.** By means of a ligature the supply of blood may be artificially cut off from the general circulation, and occasionally this may be the only means at hand.

In **cerebral congestion,** both active and passive, blood-letting may be practiced with advantage, but in the passive variety care is required that the amount of blood withdrawn affords perceptible relief, as a sufficient amount might be permitted to flow to cause untoward symptoms without any advantage to the patient.

Puerperal eclampsia is the affection which has formed the bone of contention for more than a generation, and as it is a subject of great importance its consideration merits more than a passing notice. This accident is met with in **various forms,** the chief of which are hysterical, epileptiform, apoplectiform and uræmic, and it will be required that some attention should be given to these different phases, else we shall be imperfectly prepared to cope with so formidable a malady. The **hysterical** form may be classed as physiological, and hence it would be useless,

if not harmful, to bleed; the treatment would naturally suggest the use of those remedies that are adapted for the relief of the condition in the absence of pregnancy. The **epileptiform and apoplectiform** may be classed as anatomical; at least, they are due to anatomical changes, and the first very quickly passes to the latter when not relieved, which may be sensibly lessened by the removal of pressure. No agent is so well calculated to do this as the prompt use of the lancet, and the use of **anæsthetics** and drugs to control the activity of the circulation is merely palliative and often a waste of valuable time. To be sure, the consent of the patient's friends or relatives must be obtained if the physician has time, but it is a manifest duty, and no delay should occur unless special reasons can be urged. **Uræmic** convulsions are strictly pathological; their appearance can sometimes be anticipated and an attack averted by an examination of the water, and this method should always be adopted in the later months of pregnancy with a view to ascertain the condition of the kidneys. **Pilocarpine** has been strongly urged for the relief of uræmic toxæmia, and is efficient, but we cannot afford to neglect the immediate advantages that will follow a judicious use of the lance.

Bleeding has been **freely advocated** for the relief of congestion of the kidneys, in uterine engorgement, pleurisy, peritonitis, and other abdominal affections, and in cardiac embarrassment, and in all these instances the exigencies of the case will severely tax the ingenuity of the physician. He should not forget the great value of suitable **purgatives** in these cases, and this is especially true where symptoms of intestinal sepsis exist, as such a condition frequently but adds fuel to the flame. The decided value of nux vomica or some preparation of strychnine or strophanthus is often of advantage to meet the depression following venesection, but attention to the nutrition is often of greater importance. Absorption is rapid, and liquids can be freely administered if the stomach permits, but if that organ fails rectal enemata should be ordered.

Arteriotomy has been practiced to some extent, and is said to be more easily managed in laboratory experiments, but it is so much more formidable that few are willing to undertake it, and, besides, there is some question as to the advisability of removing from the circulation blood that has been oxygenated and allowing that to remain which has become contaminated through internal respiration.

More recently **puncture of the heart** has been undertaken, but this must be considered rather experimental than practical, and, judging from the misdirected efforts of the operators, we cannot regard this operation with favor, the uncertainty of the anatomical relations rendering it a procedure of **doubtful utility.**

Local blood-letting is practiced in accordance with the same general principles governing the abstraction of blood for its constitutional effect, but we must not overlook the important fact already named, to wit., that the only function which it increases is that of absorption. Whatever method may be adopted for this purpose with a view to relieve a stagnant condition of the circulation, or for the purpose of overcoming any more deep-seated affection through its revulsive action, the **increased absorption** by the tissues is the main object to be attained, as it is largely through this mechanism that nature effects repairs to diseased tissues.

Cupping is a well-known method of procedure for the relief of local congestions, but is of more general value when the blood stasis is of the passive variety, which may be due to disease or injuries, as in the case of the eye, ear, the kidneys, or the lungs. Two methods are practiced, called "dry" and "wet cupping;" the demand for each of these will manifest itself to the intelligent physician, and as they both belong more properly to surgery than a treatise like the present but little further need be said.

Puncturing has a similar action, and may be used in like conditions, or, as in the case of "wet cups," both may be combined, but of course this latter is more formidable, and is attended with more or less pain, to which many patients will seriously object. In some skin diseases, such as chronic eczema, acne, erysipelas, and especially in the treatment of carbuncle, this method is of great value.

Scarification, like puncturing, is intended to be more superficial in its action, but is equally valuable in diseased conditions characterized by general depression of the cutaneous system. The same revulsive effects may be noted, and absorption of morbid products will be greatly facilitated.

Incisions are especially useful in irritable conditions, either general or circumscribed, where healing is prevented by what may be termed local **trophic neuroses,** of which irritable ulcers furnish an illustration. In such instances it will often be found that superficial incisions along the margin of the diseased area will be followed by prompt development of healthy granulations, although some surgeons would have us believe that this healing process is favored by permitting the detached area to occupy a portion of the excavation,—a theory which is scarcely tenable in view of our knowledge of the influence of the trophic nerves.

Leeching is often preferable to the cupping-glass owing to the fact that it is adapted to smaller areas, and can be used when it would not be available to practice cupping, as in the case of uterine engorgement, applications to the scrotum, and to the eye.

SUSPENSION.

The latest remedy recommended for the relief of **locomotor ataxia** and kindred affections is by means of suspension, which is a surgical rather than a medical topic. The present work would, however, be incomplete without some reference to this important departure for overcoming a most intractable malady. A number of observers have confirmed the first reports of Motchoukowsky, of Odessa, who first recommended it in 1883, amongst whom may be mentioned Professor Charcot, of Paris, and Weir-Mitchell, of Philadelphia, although it appears in evidence that the latter had been aware of its advantages previous to the announcement of Motchoukowsky, and refers to its application by his father, Prof. J. K. Mitchell, many years ago.

The method has doubtless been overestimated by some and underrated by others, and, while its value cannot be denied in properly selected cases, the reader should be cautioned that it is **not without danger,** as a number of accidents have been reported within the past six months. **Various views** have been promulgated to account for the benefit accruing to patients subjected to the operation, some of which may be mentioned as follows: Dr. Julius Althaus suggests that as spinal meningitis generally accompanies pathological changes in the nerve-tubes of the posterior columns, suspension produces a revulsive effect similar to that of cauterization, and, further, that the stretching process has a tendency to break down adhesions resulting from chronic meningitis, and the fact that suspension has shown itself of greater value in advanced than in recent cases apparently confirms this view.

In Prof. Charcot's cases it is said the gait of the patients promptly improved; vesical troubles, when present, disappeared, and the lightning pains subsided with a return of sexual desire and capacity, although the knee-jerk remained absent, and there was no perceptible return of the pupil reaction. Althaus outlines the **indications** for suspension in the following affections: Locomotor ataxia in the second stage, paralysis agitans, spastic spinal paralysis, amyotrophic lateral sclerosis, and functional nerve prostration. Weir-Mitchell speaks highly of its utility in Pott's disease of the spine, and insists that no case of Pott's paralysis should be considered desperate without its trial.

It remains to be added here that when this method is inaugurated the comfort of the patient should be considered as of paramount importance, and whatever the **prospective benefits** the endurance of the patient must not be exhausted.